48-HOUR WATER QUALITY MONITORING ON FOUR PRINCIPAL DRAINS ENTERING THE GRASSLAND AREA

California Regional Water Quality Control Board
Central Valley Region
3443 Routier Road
Sacramento, CA 95827-3098

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CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

The staff involved in the
preparation of this report are:

Ron Thomasson, Engineering Assistant
Chris Cooper, Engineering Assistant

Special thanks to the water and drainage districts in the area, whose cooperation made this study possible.

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INTRODUCTION

A number of agricultural discharges to Grassland Water District are sampled on a regular basis by the Agricultural Unit of the Central Valley Regional Water Quality Control Board to determine various constituent concentrations. In sampling these discharges, the "grab" method is used. Concern has arisen, however, as to whether a single sample, taken at any one time in the day, is representative of the average daily constituent concentrations. A study was undertaken to determine whether any significant diurnal variation in constituent concentration occurs and, if so, whether there is a patten to this variation. A second objective was to determine whether the "grab" method should be replaced by a composite sampling technique to obtain more accurate data. To best represent the agricultural drainage inflow to the Grassland Water District, the four largest drains; the Firebaugh Drain, the Panoche Drain, the Hamburg Drain and the Charleston Drain, were chosen for the study.

DRAINAGE CHARACTERISTICS

Together, the Firebaugh, Charleston, Hamburg, and Panoche Drains account for over 90 percent of the yearly agricultural drainage flow into the Grassland Area. Table I shows the drainage area characteristics and estimated annual flows for each drain. The Firebaugh Drain receives drainage water from four separate districts and contributes the largest annual discharge into the Grassland Area. The Panoche Drain serves a slightly larger area, but discharges slightly less annually than the Firebaugh Drain. The Hamburg and Charleston Drains have much smaller flows; nonetheless, they contribute significant flows to the Grassland Area. The major portion of the flow in these drains is subsurface agricultural drainage containing high concentrations of minerals and trace elements.

PROCEDURE

The four drains chosen for the study were sampled at their Regional Board monitoring sites. These sites were a) Firebaugh Drain at Camp 13 Slough, b) Panoche Drain at the O'Banion Gaging Station, c) Hamburg Drain at the Central California Irrigation District (CCID) Main Canal, and d) Charleston Drain at the CCID Main Canal (Fig. 1). Grab samples for mineral and selenium analyses were taken at each site every two hours for a period of 48 hours, beginning 0800 hours, 3 September 1986 and ending at 0800 hours, 5 September 1986. Field measurements of electrical conductivity and water temperature were taken at each site. Qualitative flow estimates in terms of low, medium or high were also made at each site. Additionally, a six hour selenium composite sample was made at each site for each six hour period in the study. The composite, for a given site, was formed by combining equal volumes of water taken once every two hours, from that site, for a six hour period.

Standard procedures were used to preserve both the selenium and mineral samples. The selenium samples were kept on ice until they could be preserved with nitric acid (1 ml HNO_3 per pint sample). These samples were then packaged and shipped to Sough Dakota State University for analysis. The mineral samples were kept on ice and taken to ANLAB of Sacramento for analysis directly after the completion of the study.

TABLE I

DRAINAGE AREA CHARACTERISTICS

DRAIN	TOTAL AREA (acres)	TILED AREA (acres)	TILED AREA (percent)	ANNUAL FLOW* (acre feet)
FIREBAUGH DRAIN:				
FIREBAUGH CANAL COMPANY, WIDREN WATER DISTRICT and CCID	29000	13100	45.2	20212
BROADVIEW WATER DISTRICT	9515	7410	77.8	17087
	-----	-----	----	-----
FIREBAUGH DRAIN TOTALS	38515	20510	55.0	37299
PANOCHE DRAIN:				
PANOCHE DRAINAGE DISTRICT	42300	22000	52.0	33505
HAMBURG DRAIN:				
PACHECO WATER DISTRICT	5851	3550	60.7	9053
CHARLESTON DRAIN:				
CHARLESTON DRAINAGE DISTRICT	4314	1100	25.5	2200
	-----	-----	----	-----
DRAINAGE TOTALS	90980	47160	51.8	82057

* Estimated

Source: State Water Resources Control Board Technical Committee Report: Regulation of Agricultural Drainage to the San Joaquin River (1987)

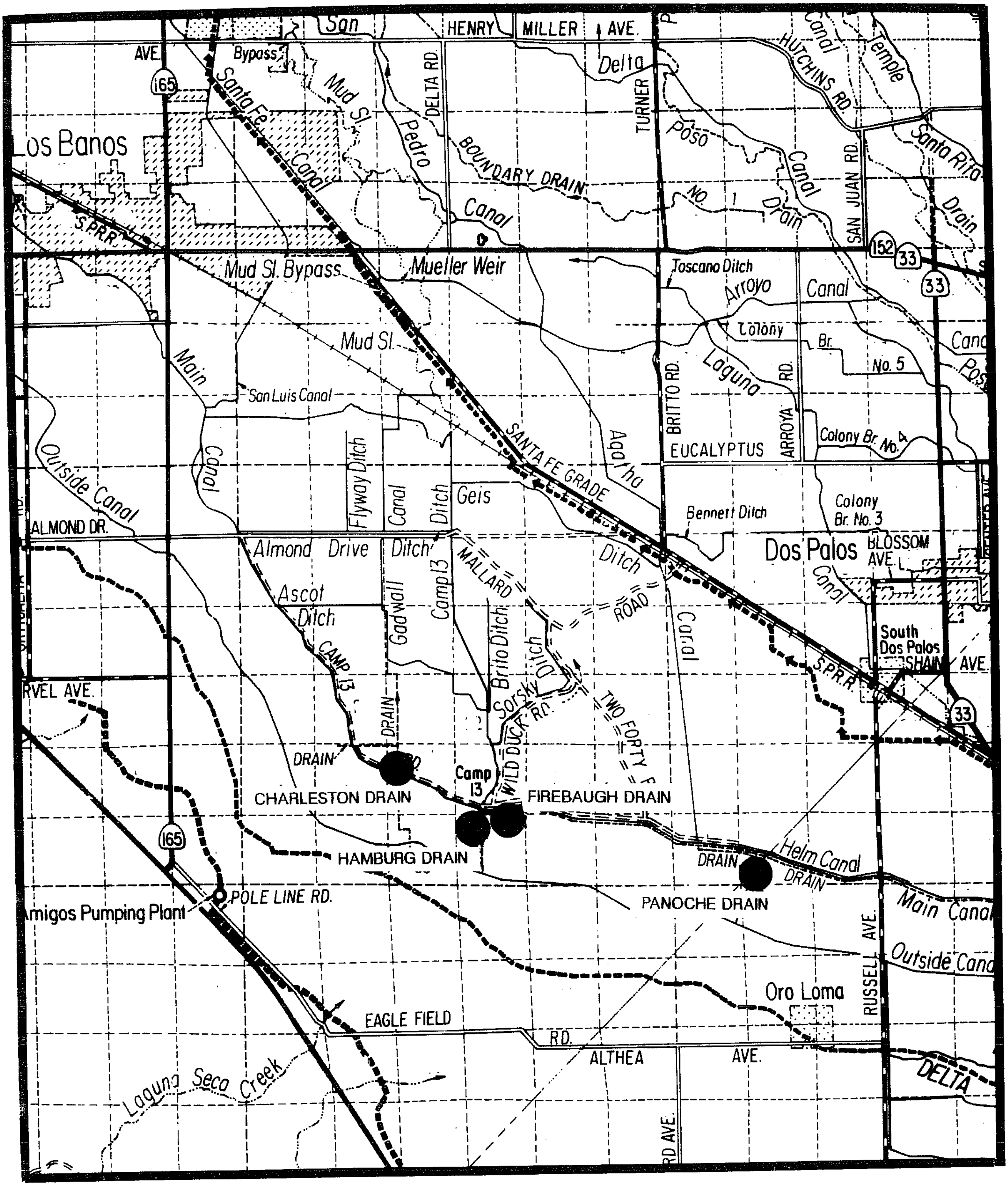


Figure 1 Site Location Map

LABORATORY QUALITY ASSURANCE

Ten duplicate selenium samples and ten duplicate mineral samples were taken to assure laboratory quality. Of the ten selenium samples, five were spiked with a solution of selenite and submitted with the duplicates and other selenium samples to South Dakota State University. The ten mineral duplicates and a mineral standard were submitted with the other mineral samples to ANLAB of Sacramento. The laboratory results of all mineral and selenium quality assurance samples were within acceptable limits.

RESULTS

Diurnal Fluctuation

Tables A1-A4 in the appendix list the bi-hourly constituent concentrations for each of the drains studied. Graphical representations of the tables are shown in figures A-F for each drain. The following is an analysis of these tables and figures to determine whether the constituent concentrations fluctuate with time, and if so, to determine a possible pattern to that fluctuation.

1) **Charleston Drain:** As shown in figures IA-IF, the concentrations of chloride, sulfate, boron, selenium and electrical conductivity for the Charleston Drain fluctuated greatly over the day, deviating as much as 65 percent from average concentrations. The general trend of the fluctuations was to approach minimum concentrations in the mid-morning and to reach maximum concentrations in the afternoon and evening with average concentrations occurring in the late morning.

2) **Hamburg Drain:** During the study, the drainage water from the Hamburg Drain was diverted and only seepage from the diversion reached the monitoring site. A subsequent discussion of the situation with Dave Dermer, Manager of Pacheco Water District, indicated that the seepage from the diversion was probably not representative of the usual discharge to the Grassland Area. Therefore the results for this drain will be regarded as inconclusive. Figures IIA-IIF show the variation that occurred in the seepage water that was sampled. These figures show a fairly large variation in concentration for each constituent, but no general pattern.

3) **Firebaugh Drain:** As illustrated by Figures IIIA-IIIF, the fluctuations of constituent concentrations were far less pronounced for the Firebaugh Drain than for the Charleston Drain. All of the constituent concentrations remained fairly constant throughout the day, rising only slightly in the afternoon. However, most deviations from mean concentrations were less than ten percent.

4) **Panoche Drain:** As shown by figures IVA-IVF, the Panoche Drain exhibited more variation than did the Firebaugh Drain, however considerably less than the Charleston Drain. The general trend for the Panoche Drain constituent concentrations was to reach maximums in the morning and minimums in the evenings. Average concentrations were reached in the late morning. However, these fluctuations were relatively small, with most concentrations deviating from mean concentrations by 10 percent or less.

The above analysis showed that daily patterns do exist in these drains. However, with the exception of the Charleston Drain, the fluctuations are small, with most less than ten percent of mean concentrations. It also showed that the Charleston Drain reaches average concentrations in the late morning.

Comparison of Sampling Methods

Tables B1-B4 in the appendix compare bi-hourly selenium concentrations obtained by the grab method to those obtained by the composite method. The accuracy of the two methods were compared on the basis of a 24-hour average selenium concentration. This average was computed as the arithmetic mean of four 6-hour composites. Graphical representations of the tables are shown in figures IG-IVG. The following is an analysis of these tables and graphs to determine whether a composite sampling method yields more accurate data than the grab method now in use.

1)**Charleston Drain:** The data in table C1 shows that the difference between the calculated average daily selenium concentration and that obtained by a single grab sample ranged from 1 to 40 percent with an average of 19 percent. This is a fairly significant deviation. However, the composite method fared only slightly better, with deviations ranging from 2 to 25 percent and averaging 15 percent. As is seen in figure IG, use of the composite method has the effect of damping the peak deviations obtained by the grab method, however, producing only 4 to 5 percent better results on average.

2) **Hamburg Drain:** As noted previously, the results for the Hamburg Drain are probably not representative of its usual discharge to the Grassland Area. However, this data will be used in a comparison of methods analysis, but should not be regarded as representative of the Hamburg Drain discharge.

The data from the Hamburg Drain was quite similar to that of the Charleston Drain. The deviation in the grab method ranged from 0 to 35 percent with an average of 17 percent. The composite method ranged in deviation from 8 to 31 percent, also averaging 17 percent. Figure IIG shows that the composite method reduces the peak deviations obtained by the grab method, but that the results obtained, on average, are virtually the same.

3) **Firebaugh Drain:** As shown in figure IIIG, the two sampling methods differed very little for the Firebaugh Drain. The grab method deviation ranged from 0 to 9 percent, with an average of 2 percent. The composite method deviation ranged from 0 to 4 percent, also averaging 2 percent. The figure shows that the composite method reduces the peak deviations obtained by the grab method, but that the results obtained, on average, produced no better results.

4) **Panoche Drain:** Figure IVG shows the comparison of methods for the Panoche Drain. The grab method showed deviations ranging from 0 to 30 percent, with an average of 8 percent. The composite method obtained only slightly better results, with deviations ranging from 0 to 21 percent and averaging 6 percent. The figure shows the same general trend as the other three drains. The composite method reduced the maximum grab method deviation but on average yielded only slightly better results.

The analysis showed that a composite sampling method could reduce the average deviation obtained by the grab method up to 5 percent. However, the biggest advantage in replacing the grab method by a composite method would be the damping of peak deviations obtained by the grab method. The maximum deviation reduction occurred with the Charleston Drain, where the peak deviation was reduced 15 percent, from 40 to 25 percent. The peak deviation reduction for the other three drains was much less pronounced, ranging from a reduction of 8 percent for the Panoche Drain to 5 percent for the Firebaugh Drain.

In addition to the above analysis, the relationship between grab method deviation and yearly flow was investigated. Figure V is a plot of yearly flow rate versus average grab method deviation. Although there is not enough data for a statistical analysis, it does show an expected result. The figure shows that a drain with a large flow will produce a smaller deviation than that of a drain with a smaller flow.

CONCLUSIONS AND RECOMMENDATIONS

Analysis of the data indicated that each drain had a unique diurnal flow pattern. The larger drains, Firebaugh and Panoche, showed relatively small fluctuation throughout the day. Therefore, little accuracy is lost in assuming that grab sample concentrations approximate average daily concentrations in these drains. The constituent concentrations in the much smaller Charleston Drain fluctuated much more, with deviations from mean concentrations of up to 65 percent. Therefore, in making the assumption that the average daily concentrations are approximated by grab sample concentrations, a fairly significant error could result.

To reduce the possibility of a large error occurring, it is recommended that sampling take place when mean concentrations are likely to occur. The data suggests that mean concentrations occur in the late morning for the Charleston Drain. It also suggests that the Firebaugh and Panoche Drains maintain relatively stable concentrations throughout the day, and therefore any sampling time would be representative of the daily averages. However, this data was obtained over a 48-hour period in early September and may not be representative of diurnal fluctuations which may occur at other times of the year. More studies should be conducted to verify these flow patterns before any conclusions, as to the best sampling times, are made. No conclusions as to the Hamburg Drain may be drawn, due to its questionable data.

The analysis of the Firebaugh and Panoche Drain data showed that very little accuracy could be gained in changing from the grab method to the 6-hour composite method. The Charleston Drain data showed that the composite method would yield approximately 5 percent better results on average and reduce possible peak deviation by 15 percent. Considering the additional time and effort required for composite sampling, this small gain in accuracy could be obtained in a more economical way, such as sampling when average concentrations are likely to occur. Therefore, it is recommended that a composite sampling method should not be used for any of these drains. It should be noted, however, that deviation tends to increase as annual flow decreases as shown in figure V. Since the drains studies have relatively high annual flows, the composite method should not be ruled out for smaller drains in the Grassland Area.

FIGURE IA

CHLORIDE CONCENTRATIONS AT CHARLESTON

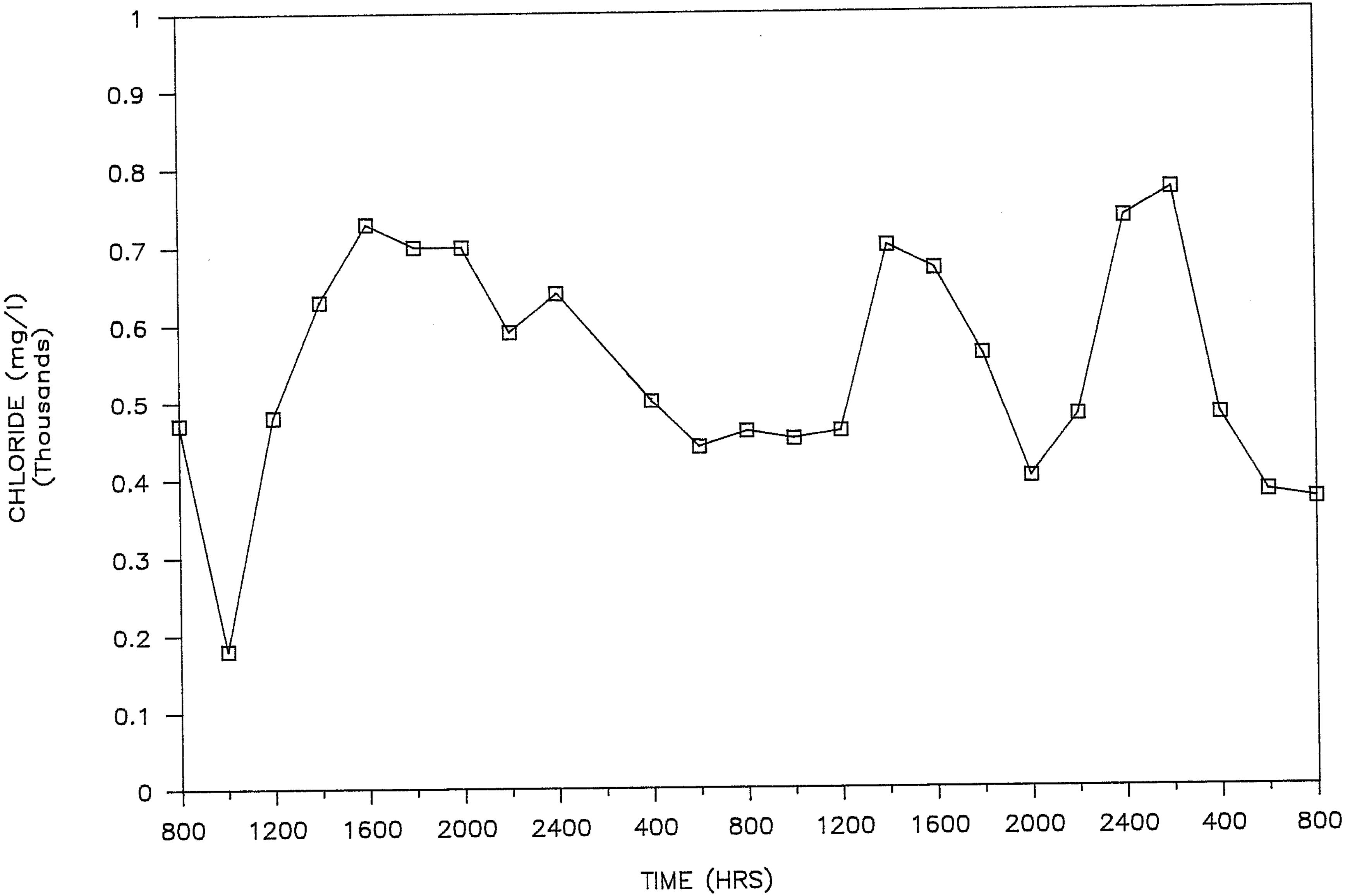


FIGURE IB

SULFATE CONCETRATIONS AT CHARLESTON

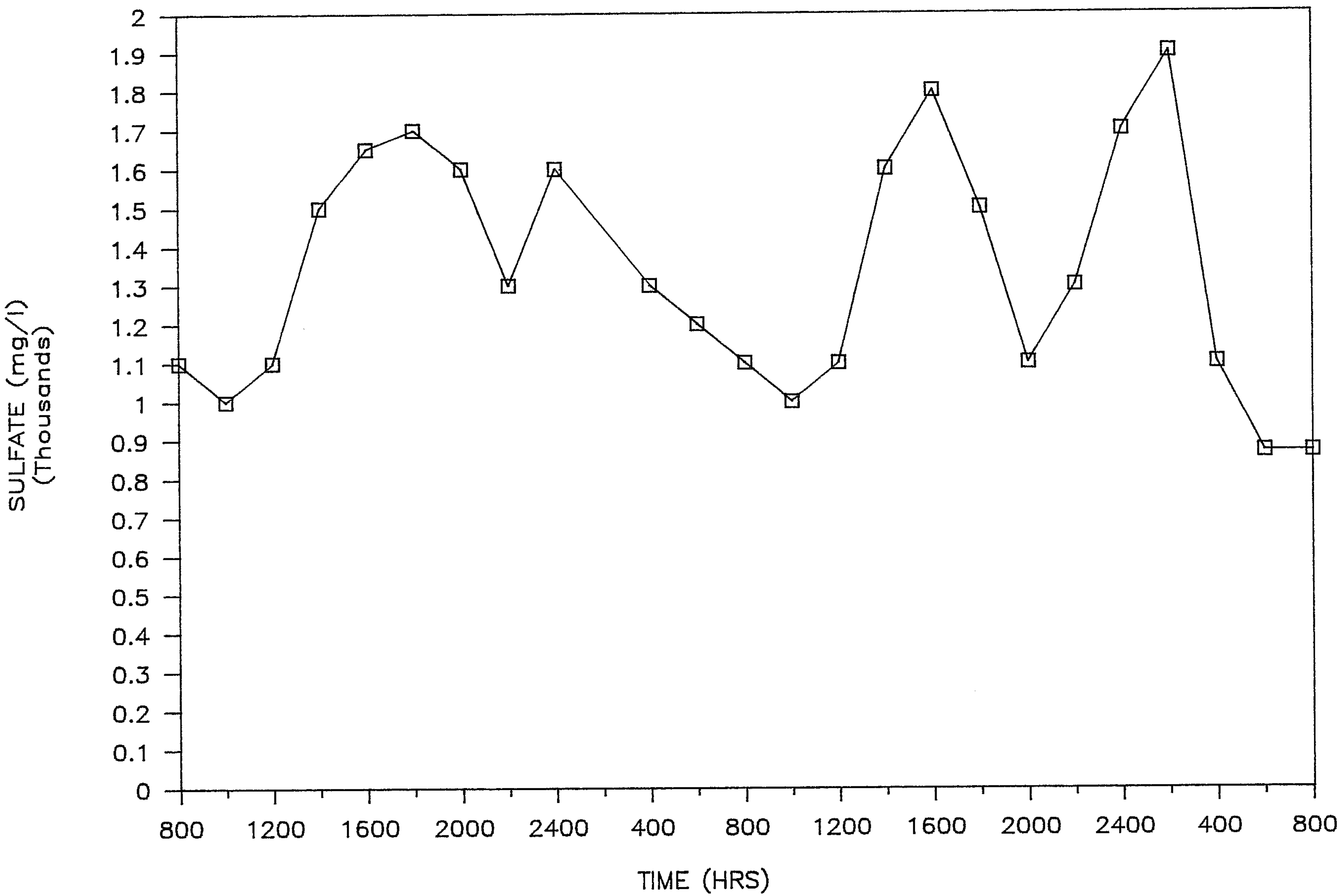


FIGURE IC

TOTAL ALKALINITY AT CHARLESTON

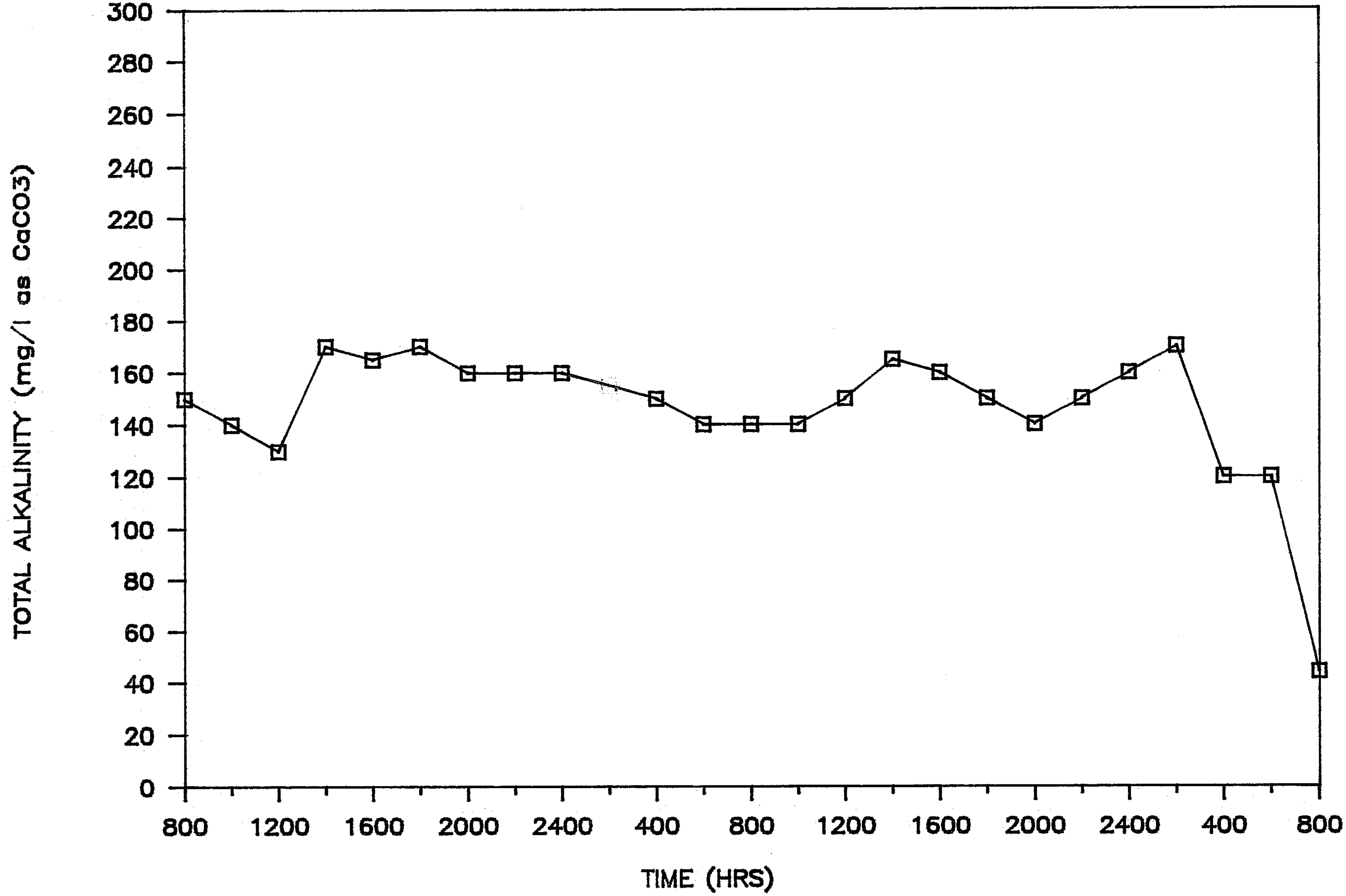


FIGURE ID

SPECIFIC CONDUCTIVITY AT CHARLESTON

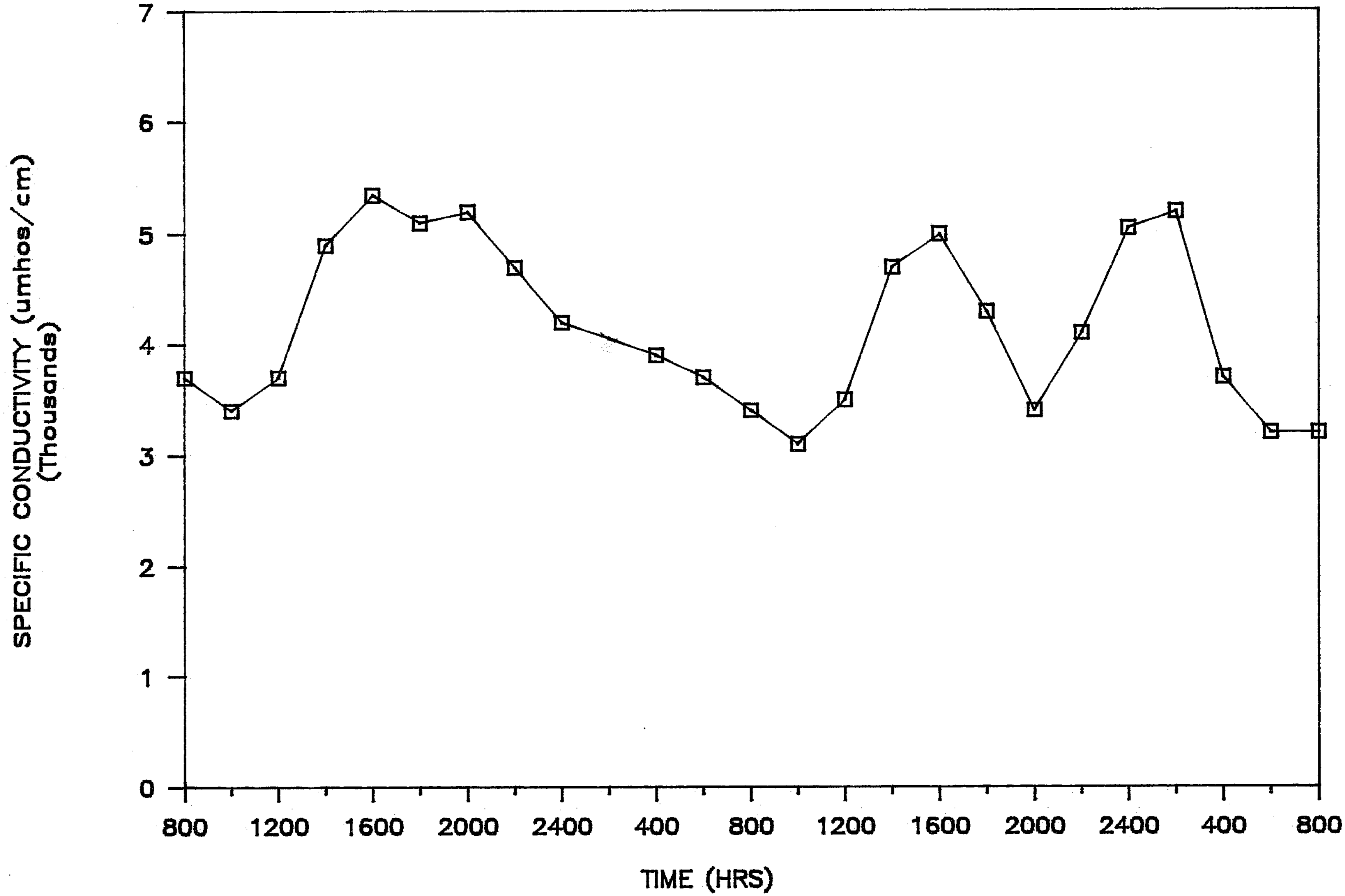


FIGURE IE

BORON CONCENTRATIONS AT CHARLESTON

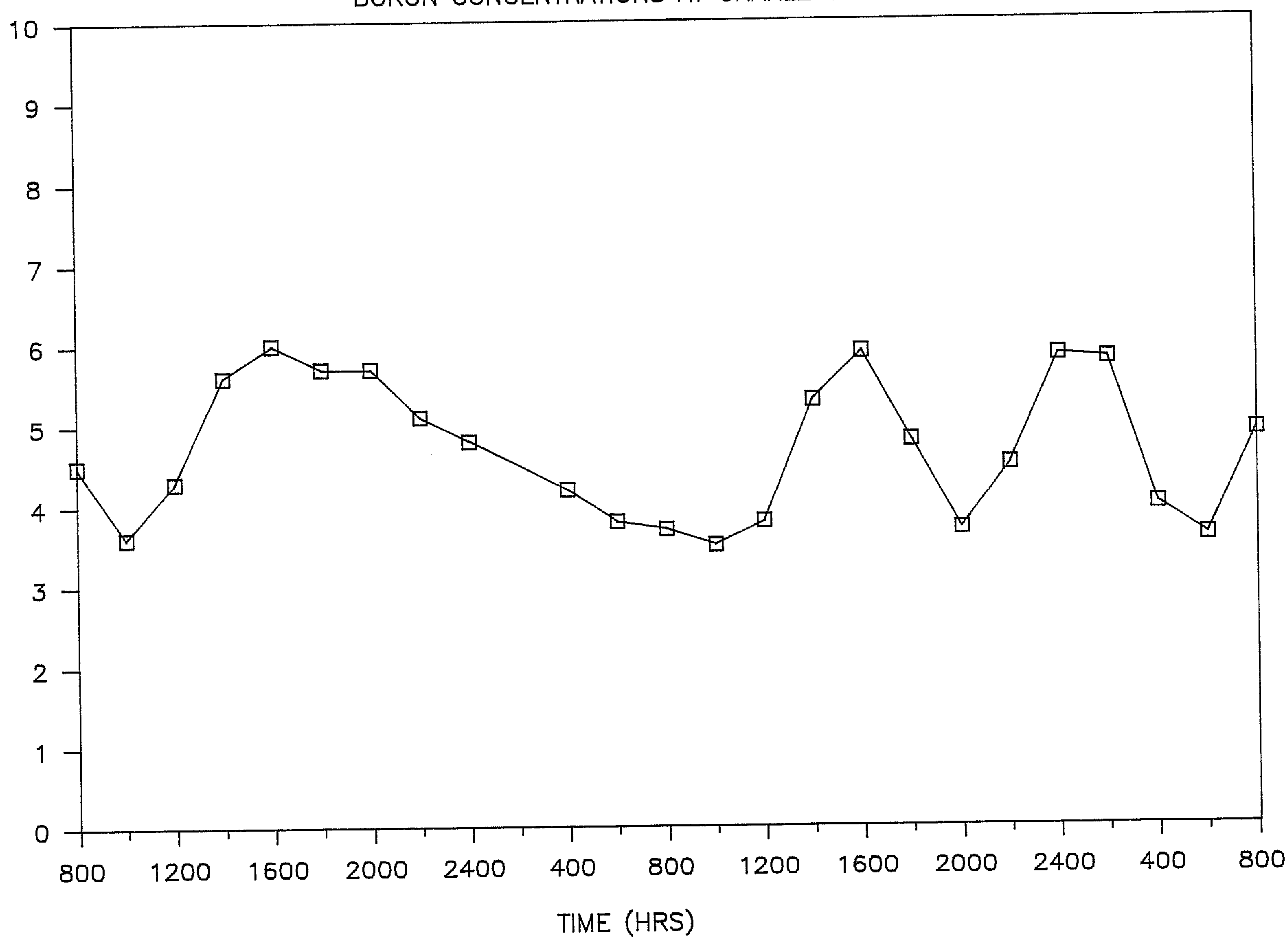


FIGURE IF

SELENIUM CONCENTRATIONS AT CHARLESTON

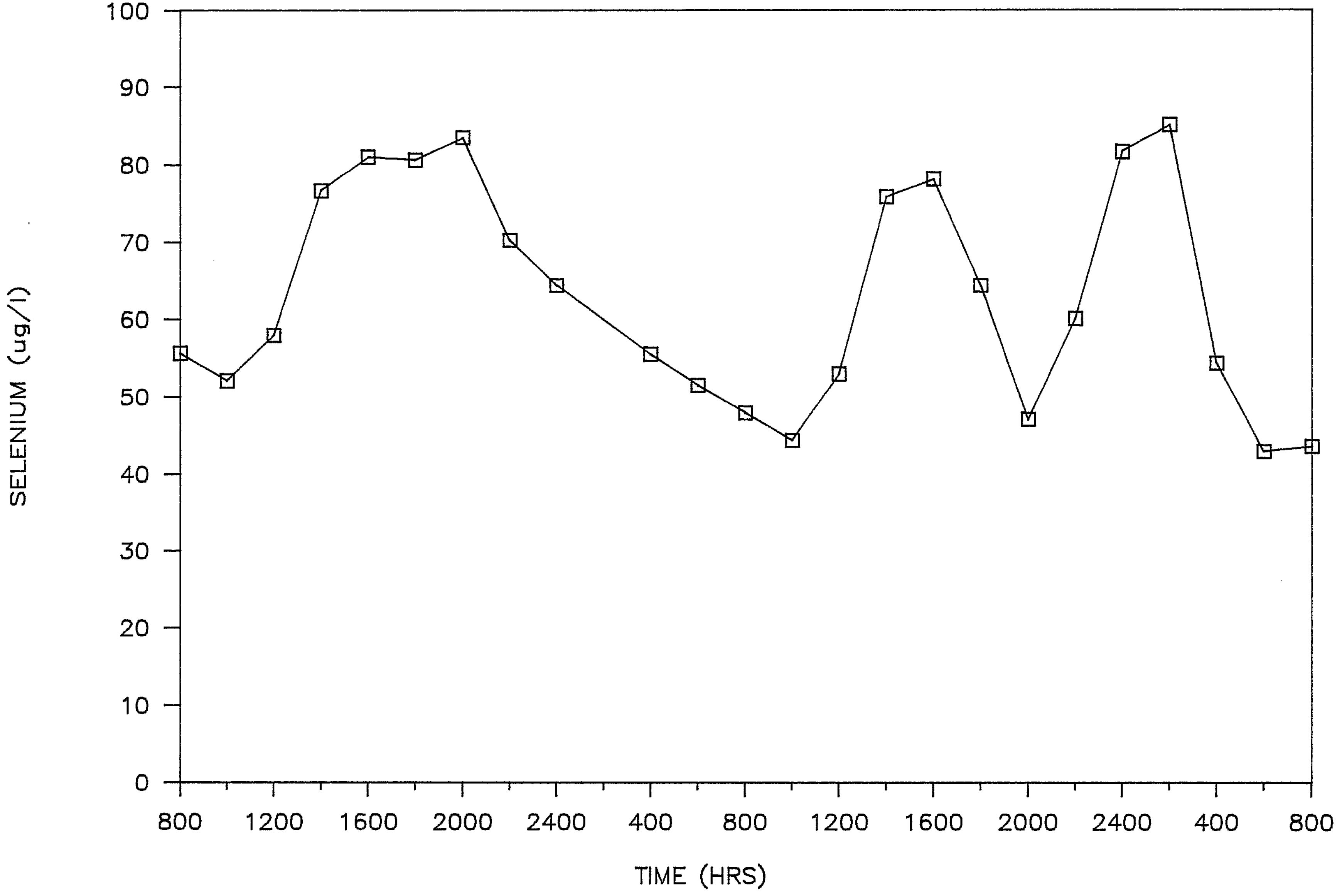


FIGURE IIA

CHLORIDE CONCENTRATIONS AT HAMBURG

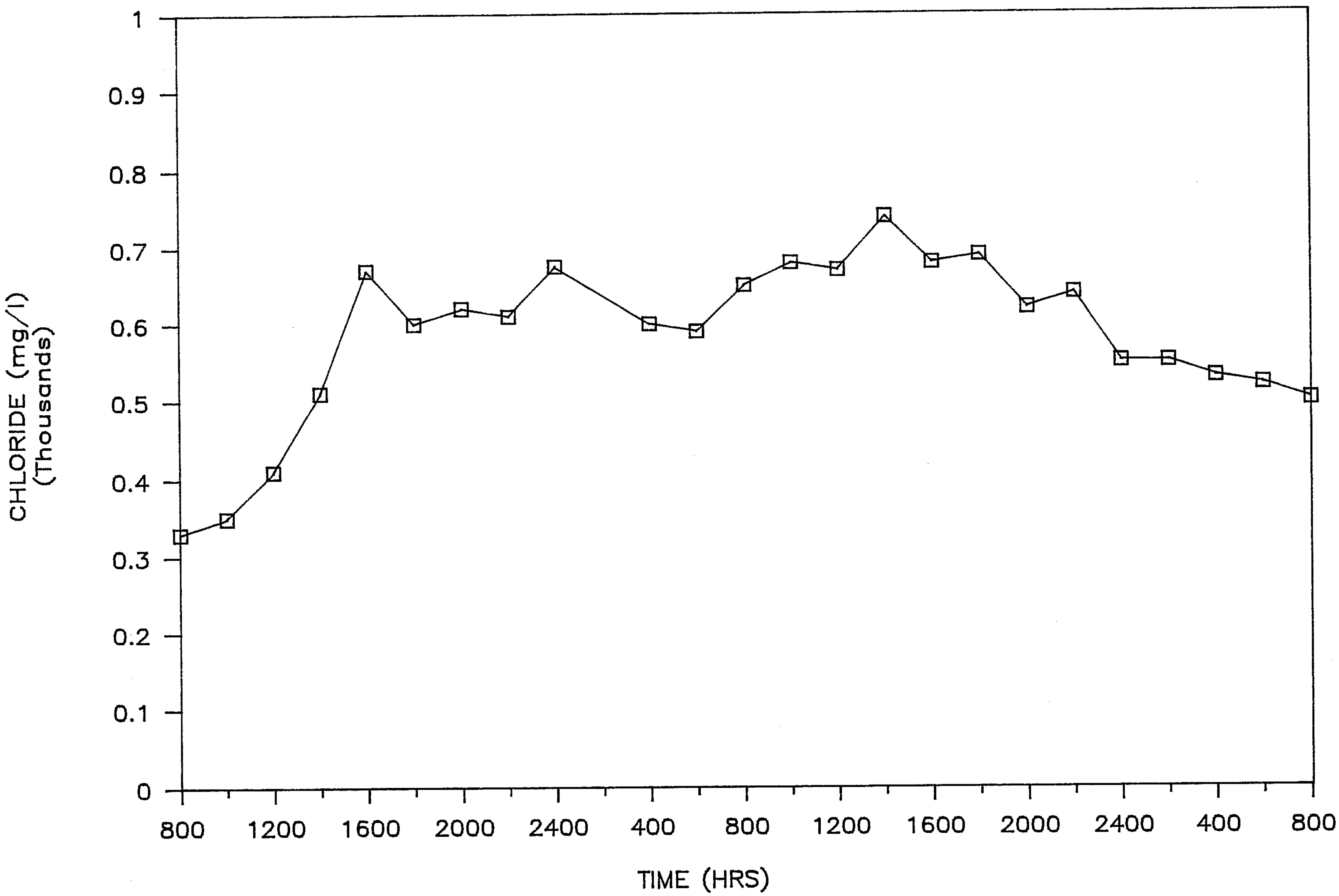


FIGURE IIB

SULFATE CONCETRATIONS AT HAMBURG

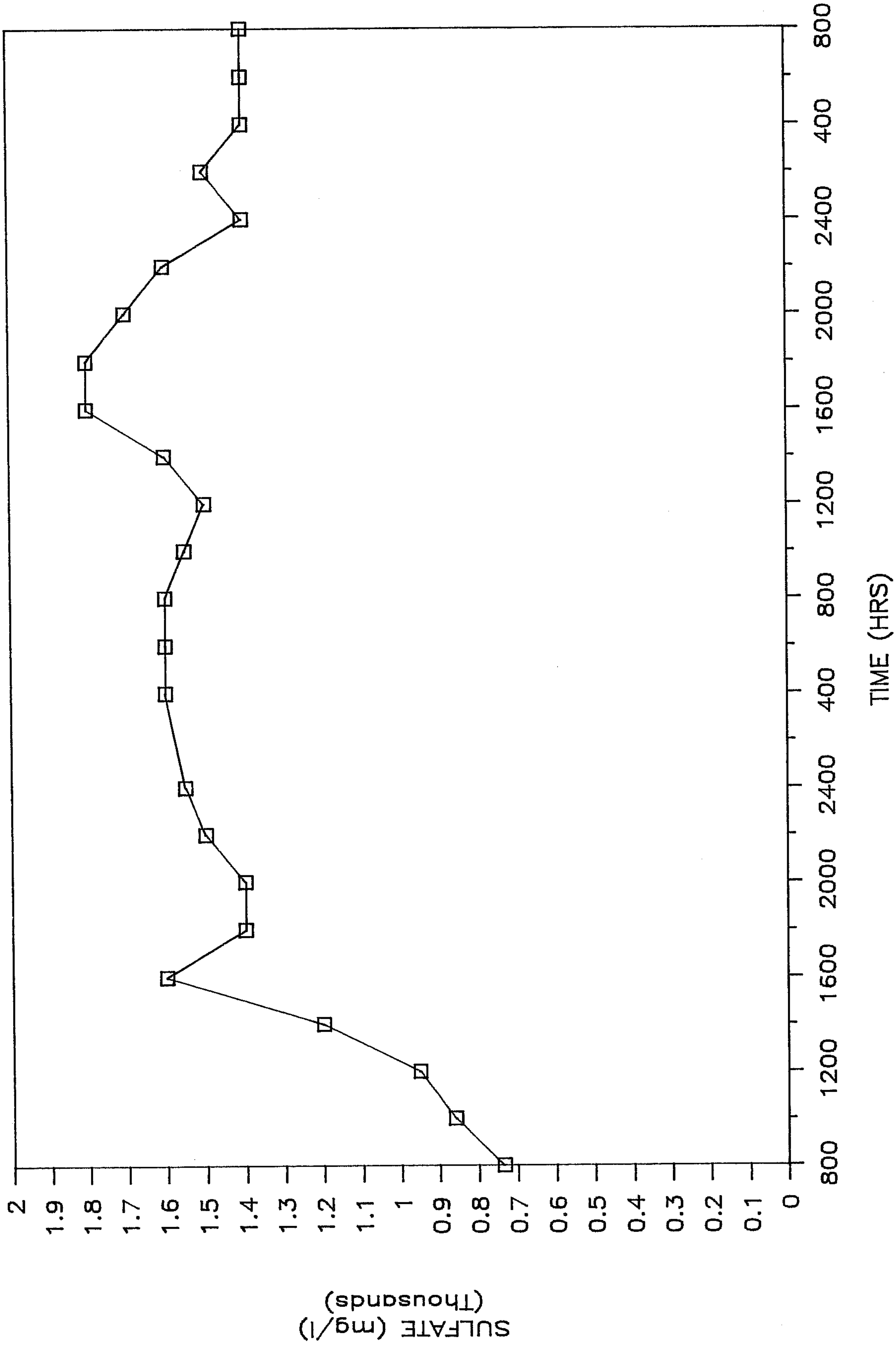


FIGURE IIC

TOTAL ALKALINITY AT HAMBURG

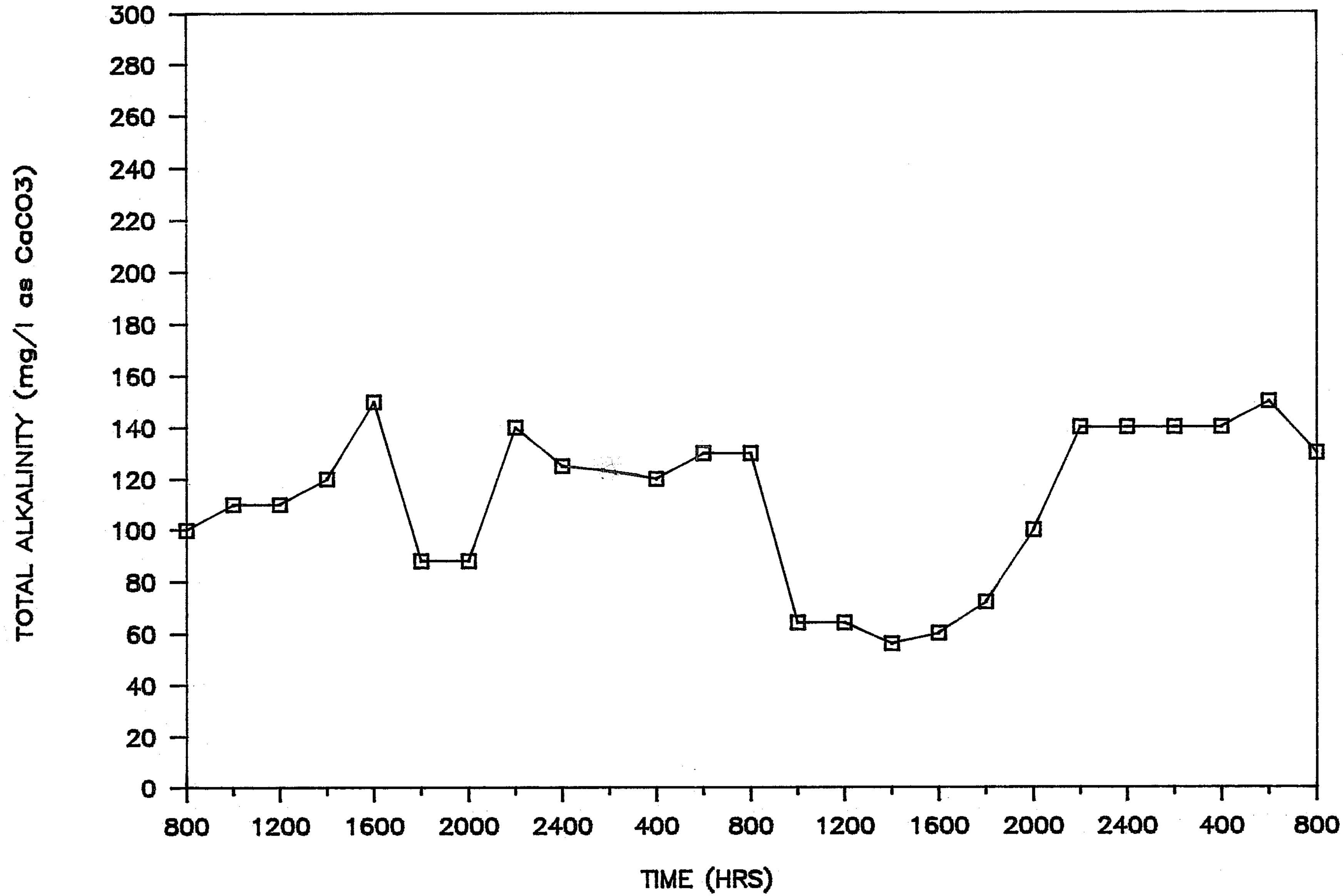


FIGURE IID

SPECIFIC CONDUCTIVITY AT HAMBURG

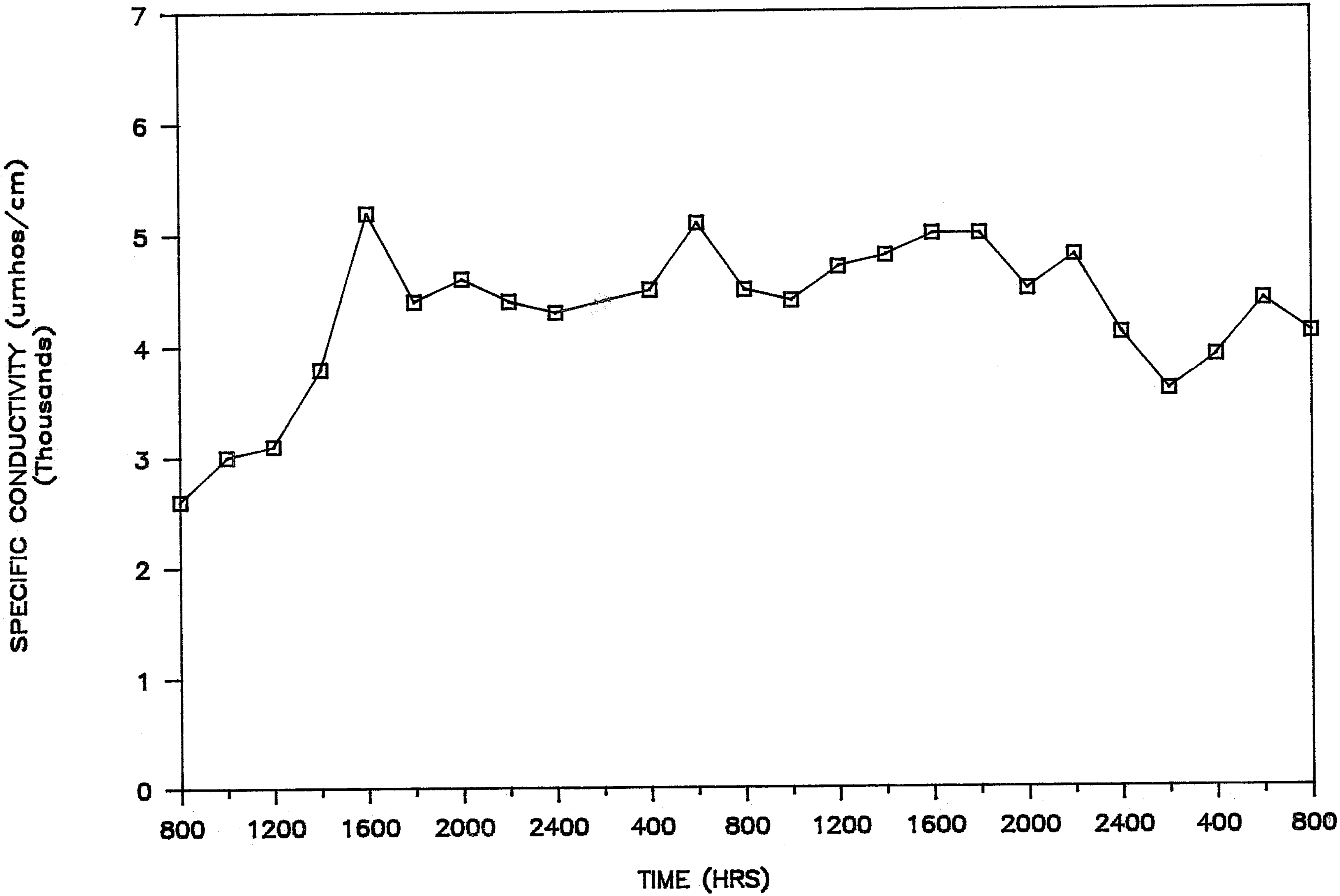


FIGURE IIE

BORON CONCENTRATIONS AT HAMBURG

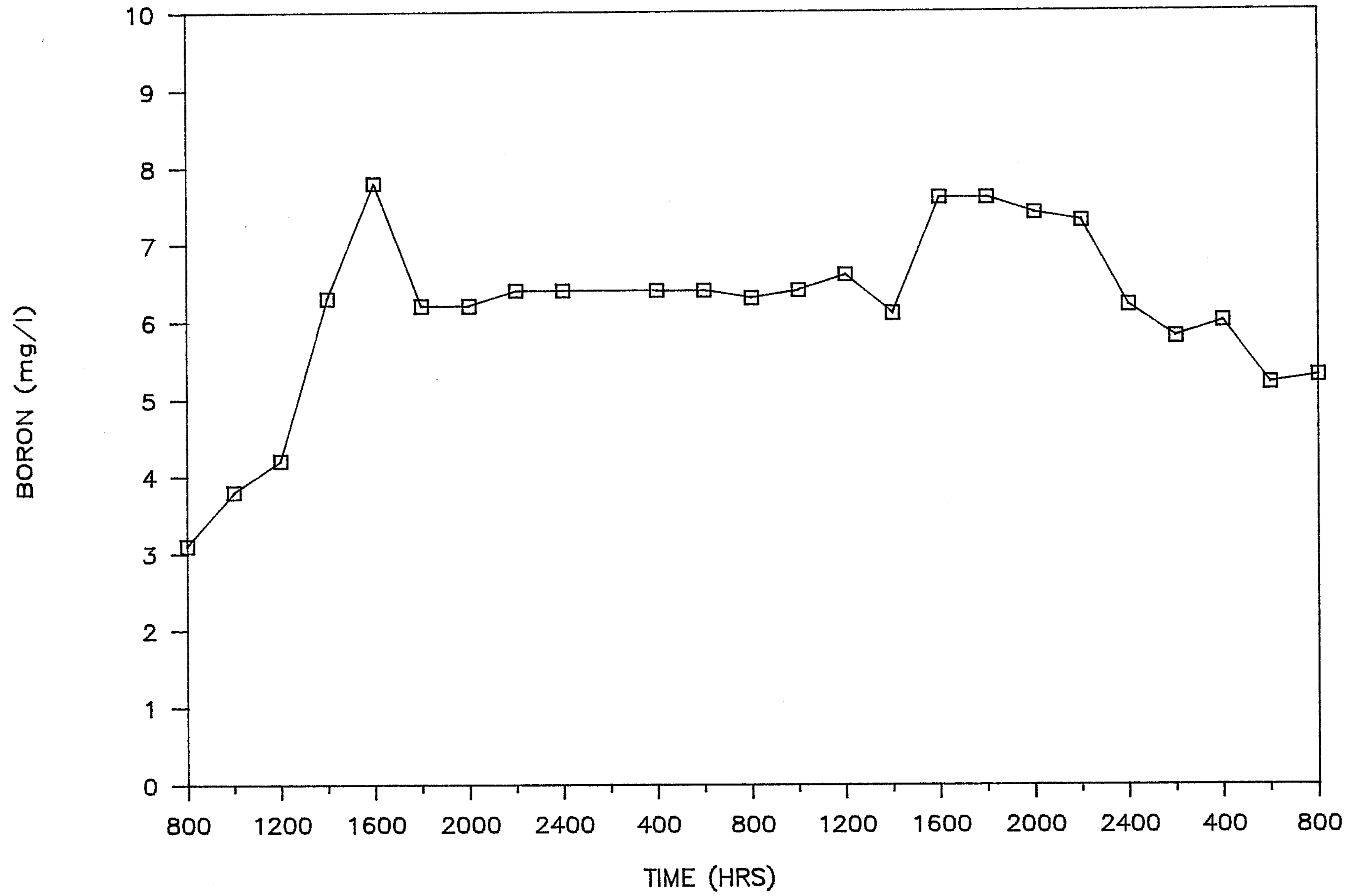


FIGURE IIF

SELENIUM CONCENTRATIONS AT HAMBURG

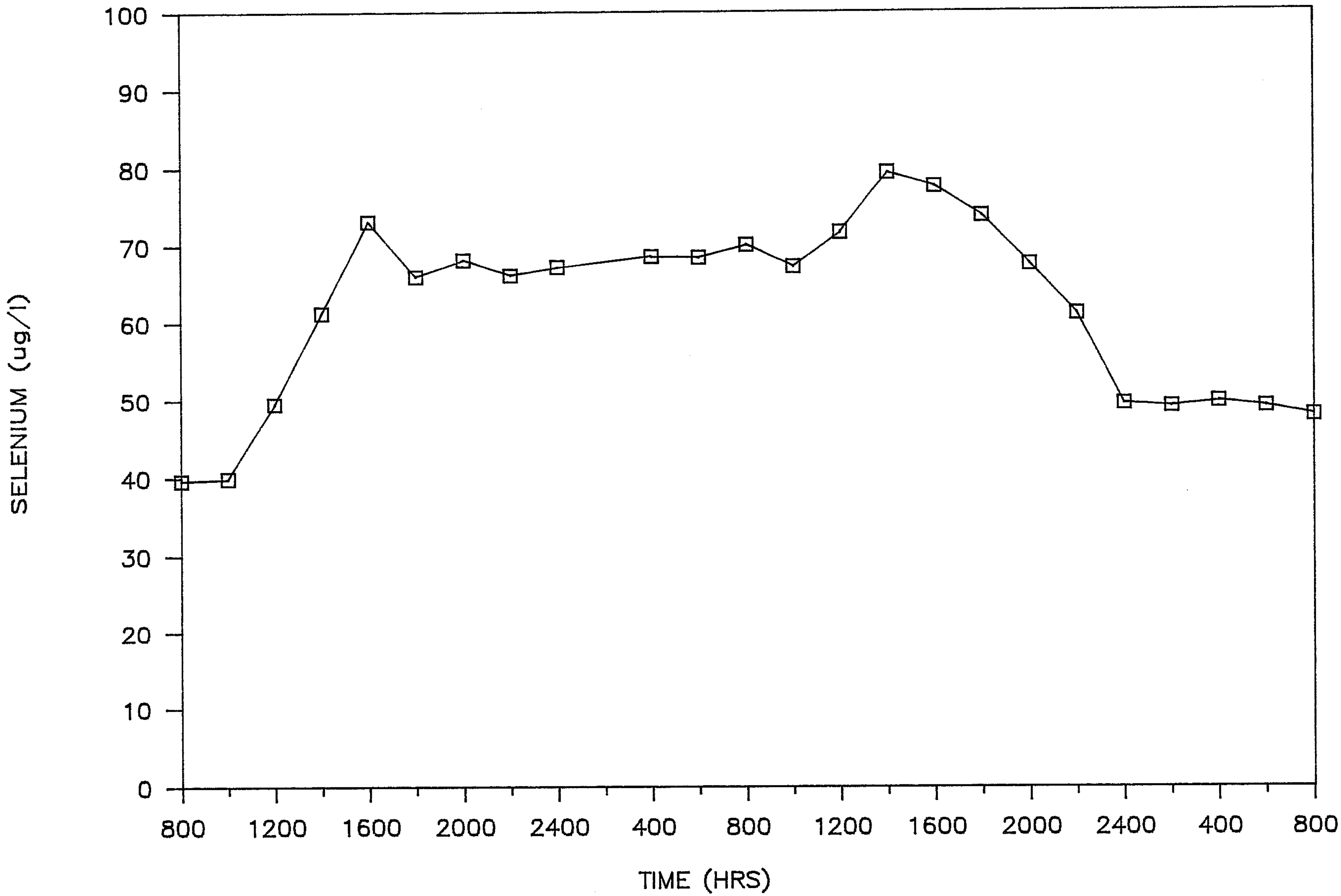


FIGURE IIIA

CHLORIDE CONCENTRATIONS AT FIREBAUGH

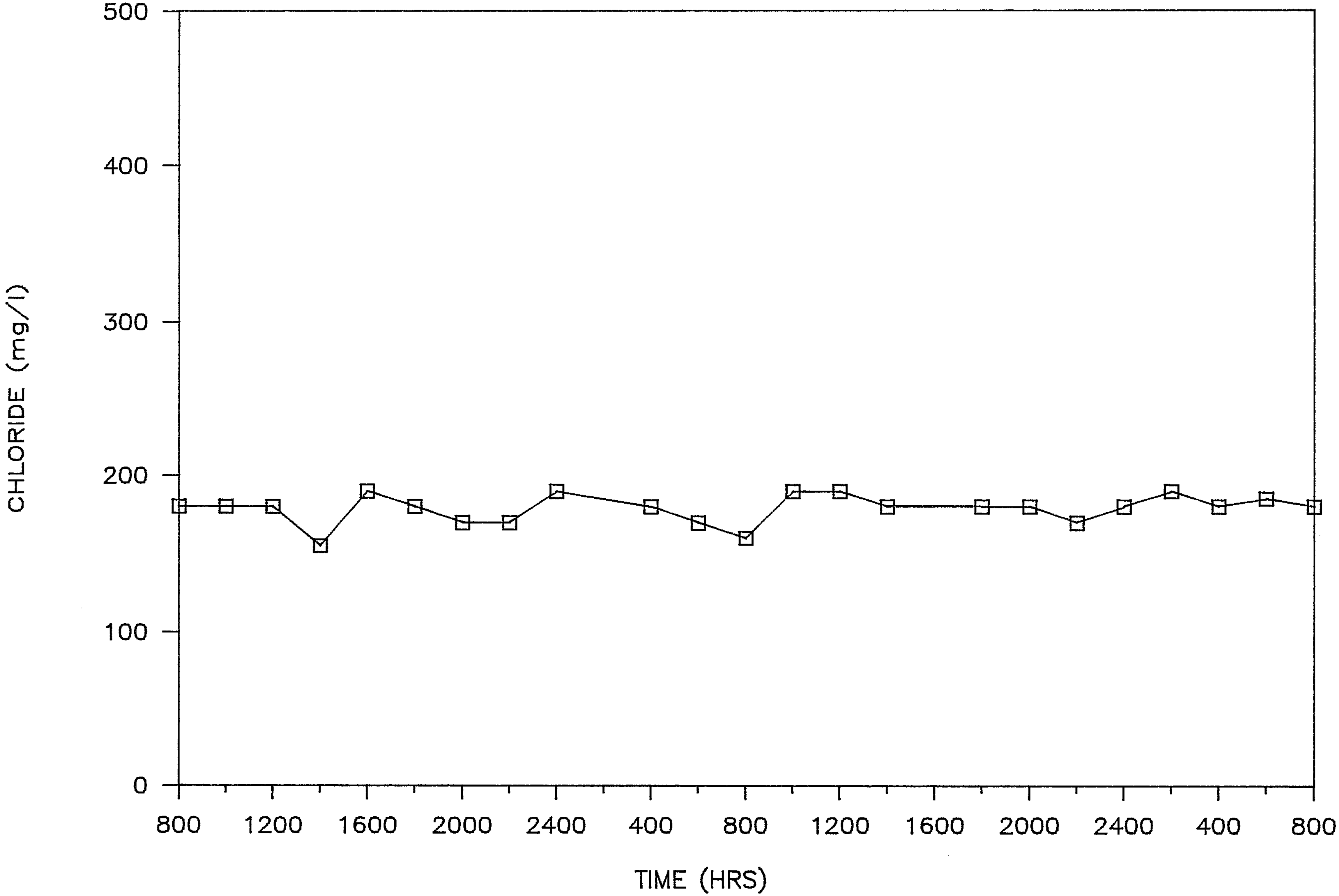


FIGURE IIIB

SULFATE CONCETRATIONS AT FIREBAUGH

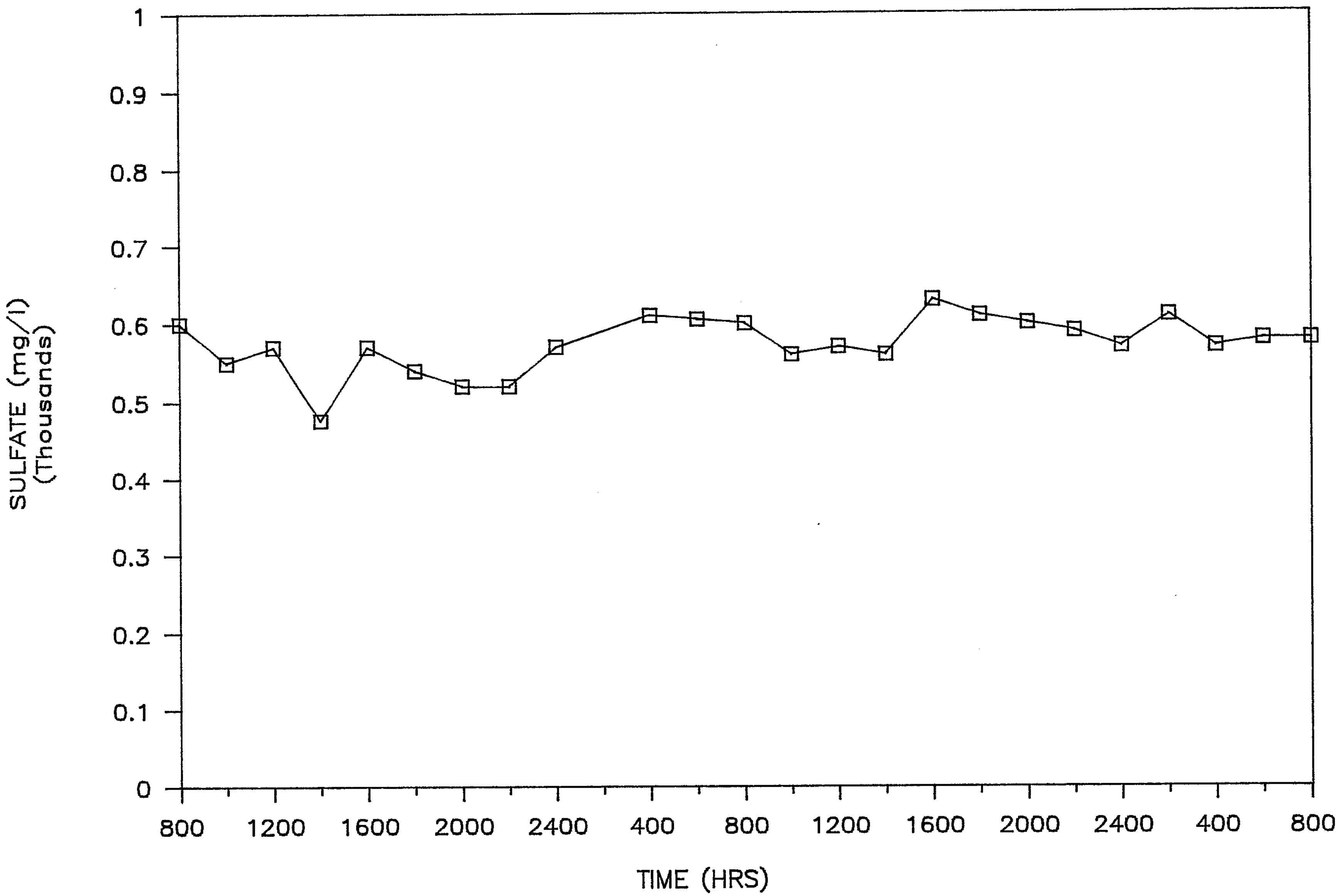


FIGURE IIIC

TOTAL ALKALINITY AT FIREBAUGH

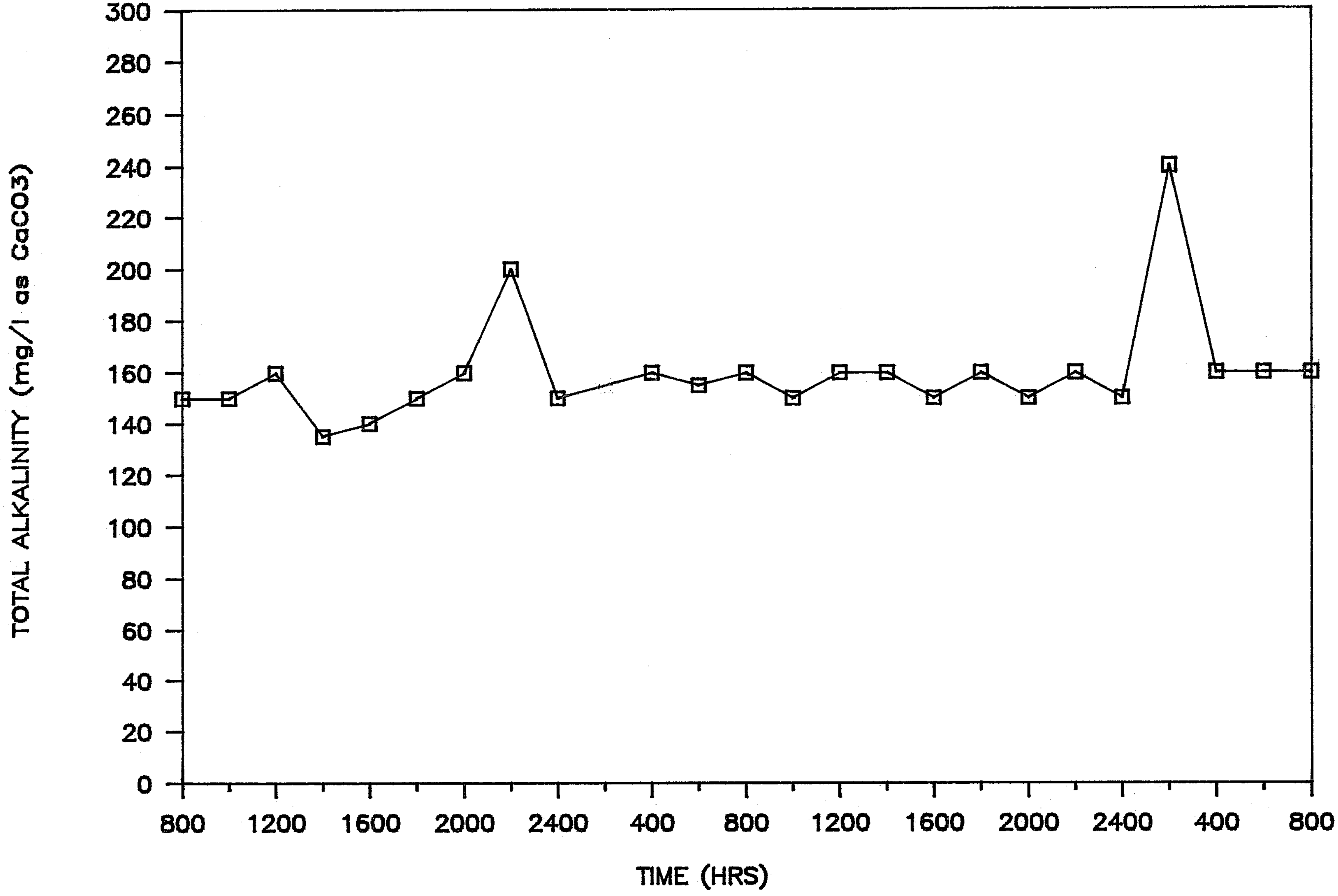


FIGURE IIID

SPECIFIC CONDUCTIVITY AT FIREBAUGH

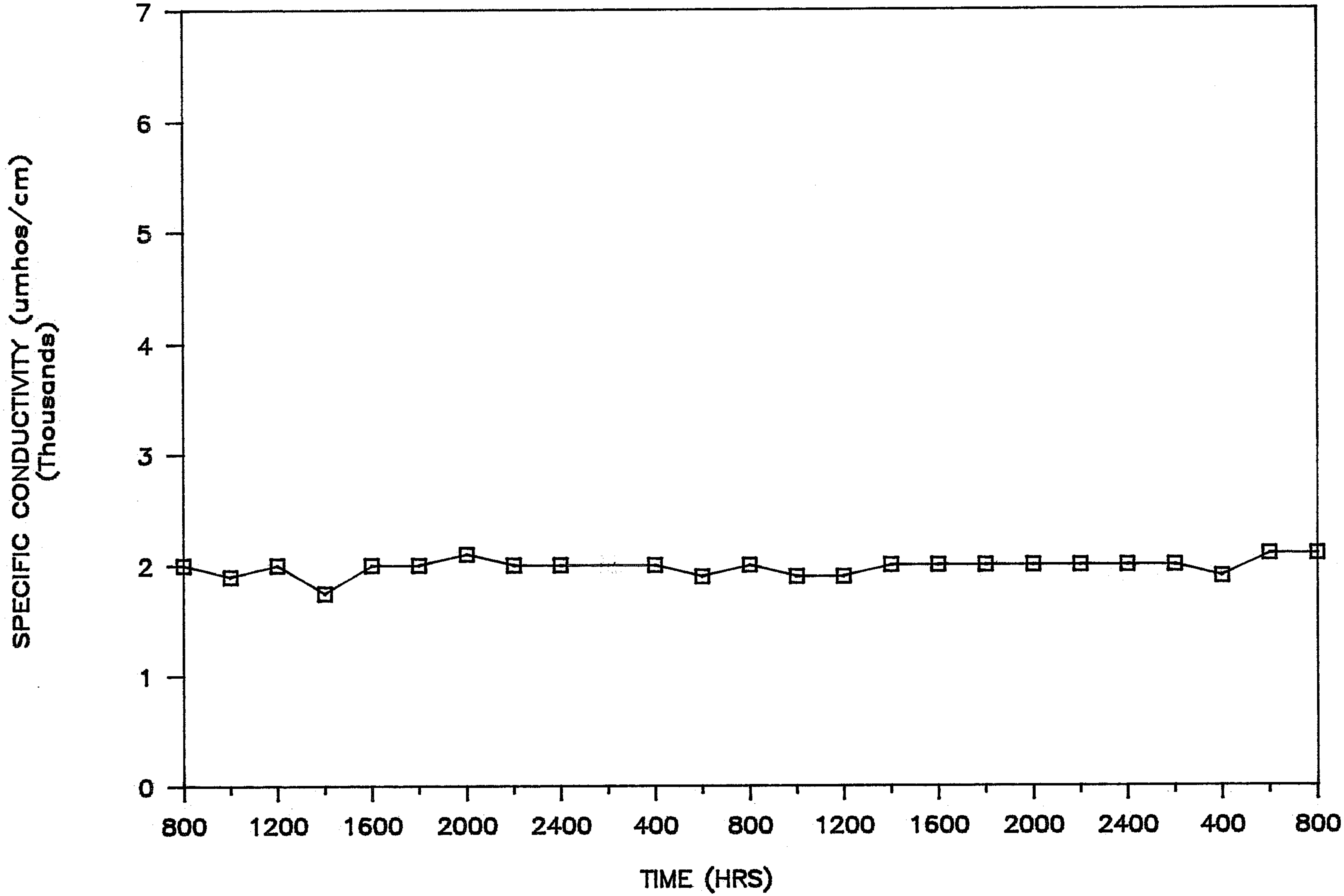


FIGURE IIIE

BORON CONCENTRATIONS AT FIREBAUGH

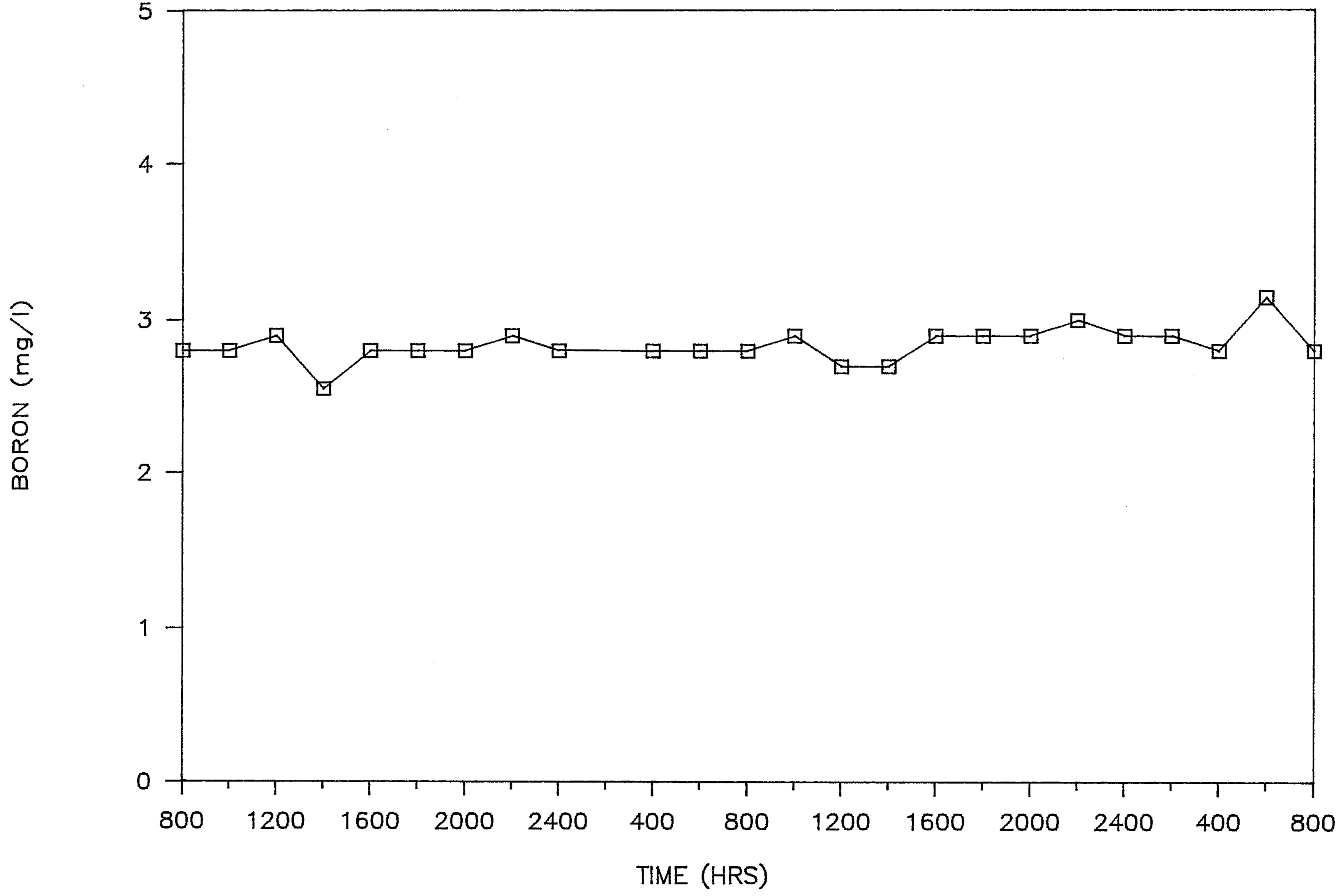


FIGURE IIIF

SELENIUM CONCENTRATIONS AT FIREBAUGH

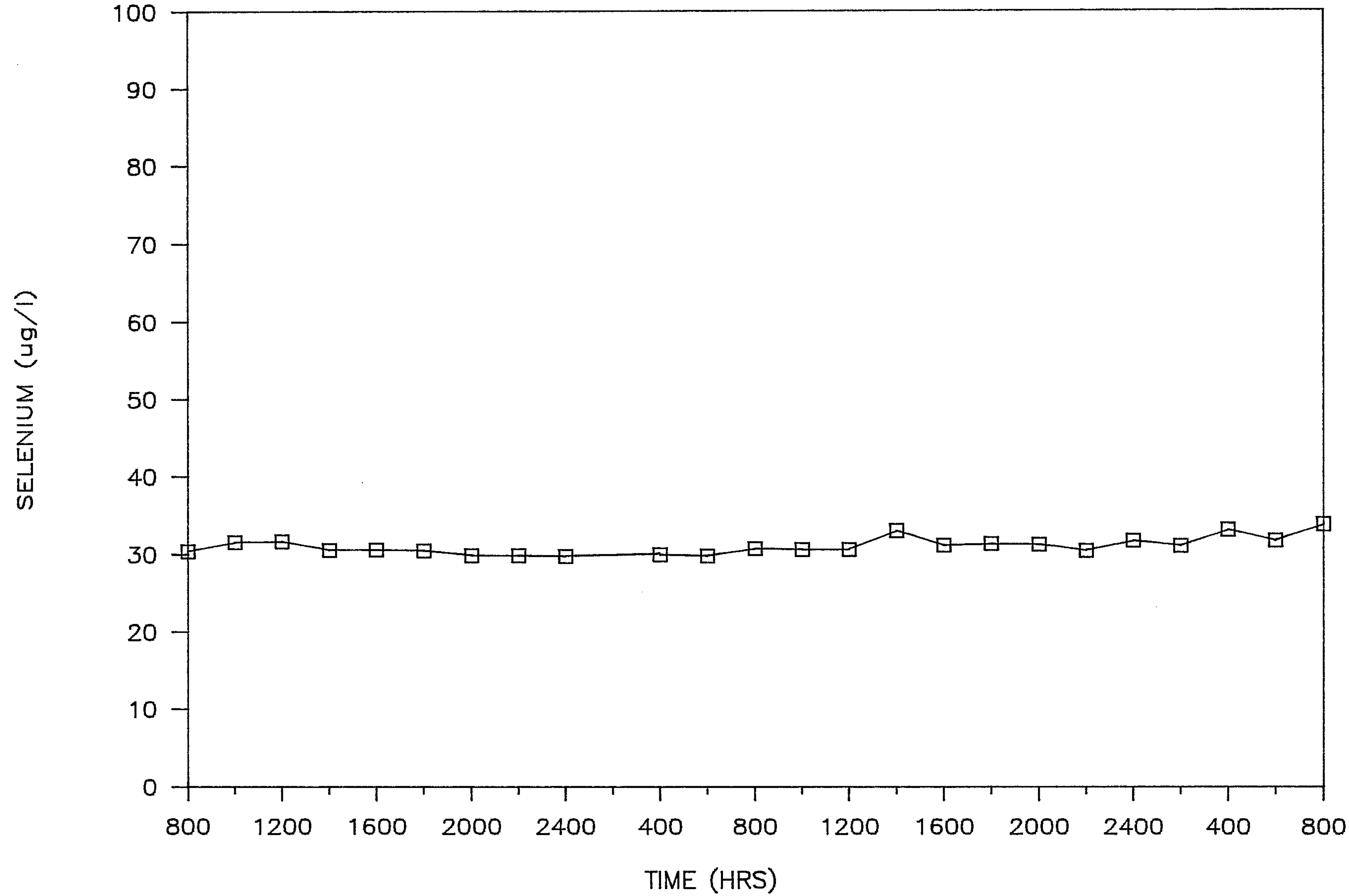


FIGURE IVA

CHLORIDE CONCENTRATIONS AT PANOCHE

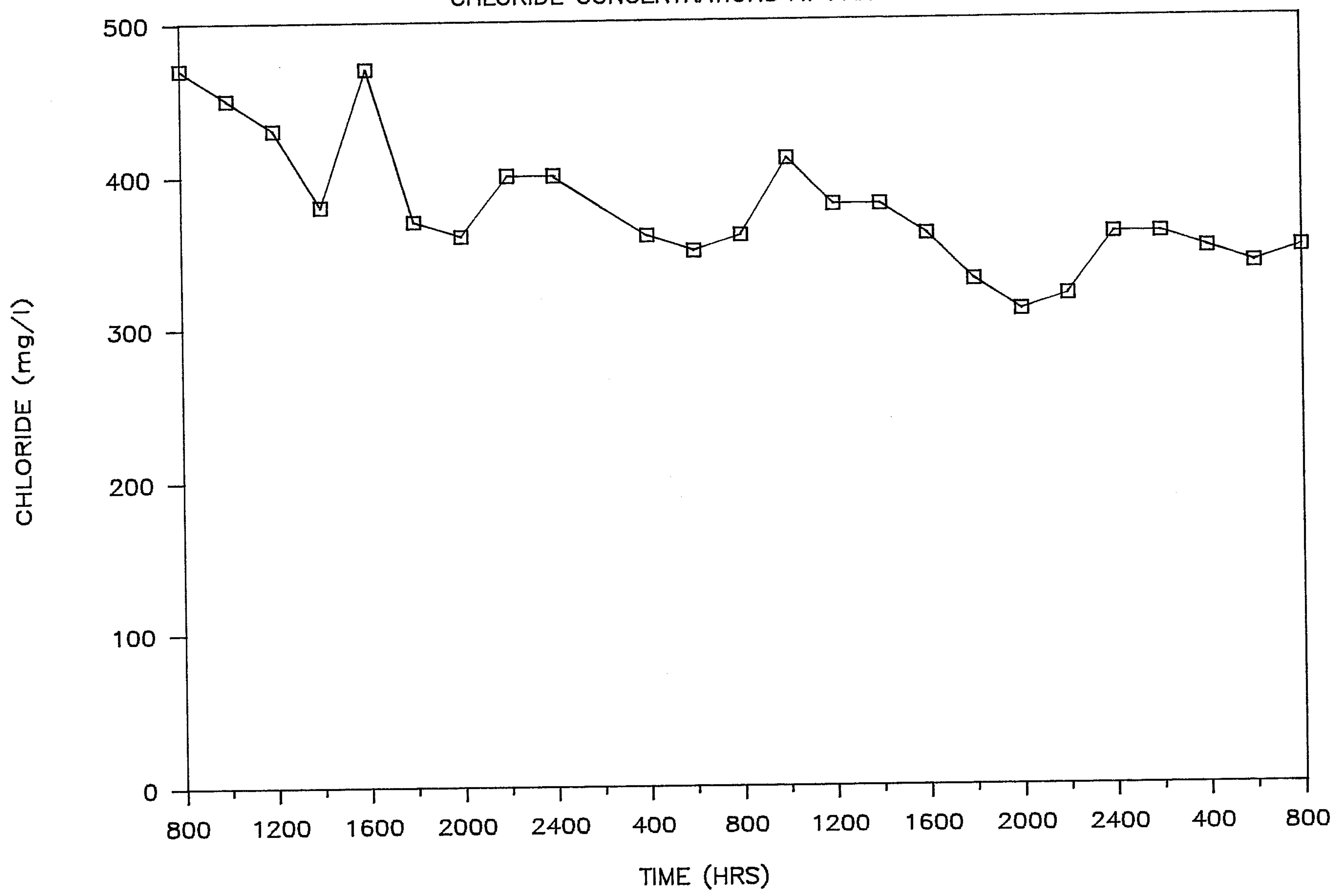


FIGURE IVB

SULFATE CONCENTRATION AT PANOCHE

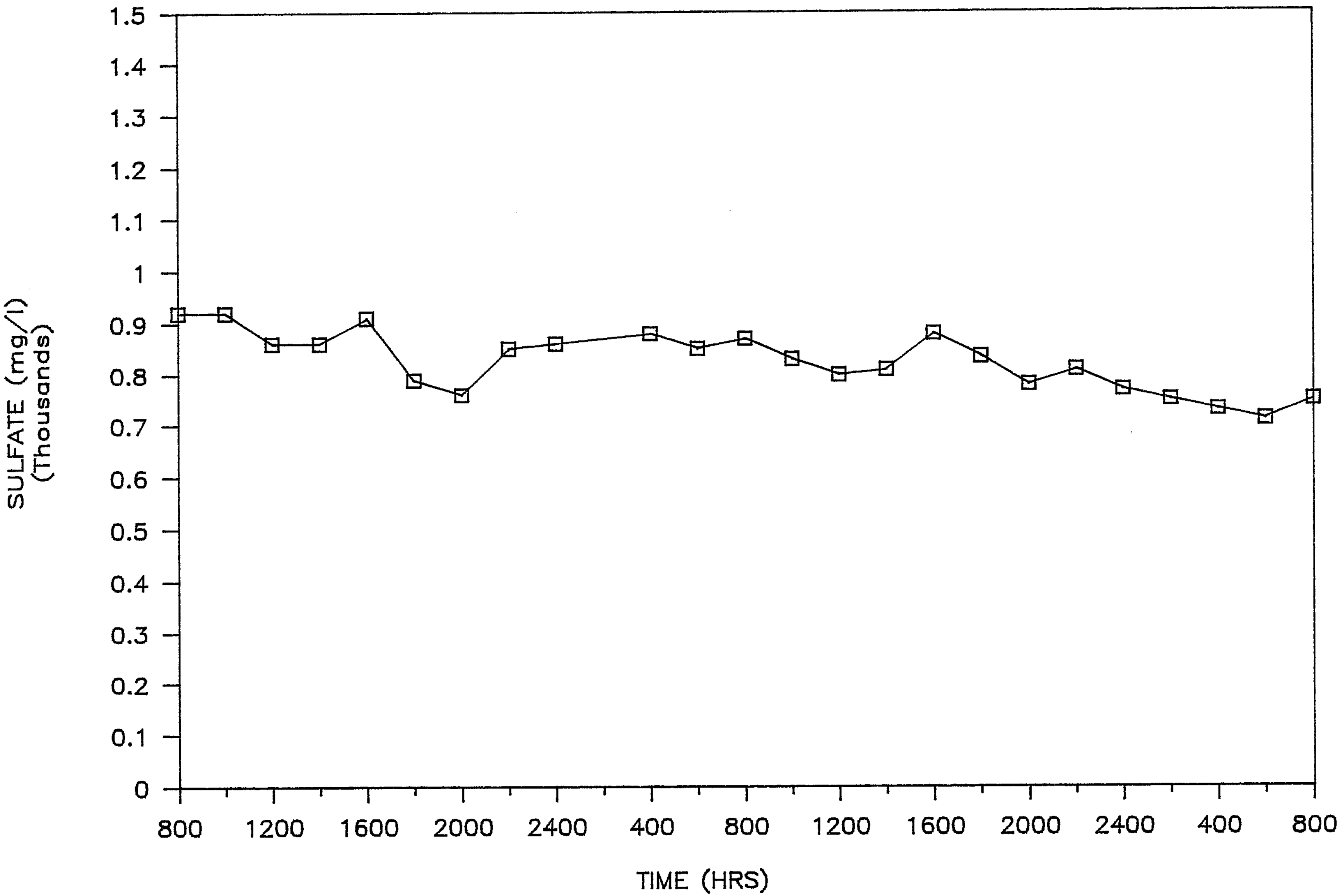
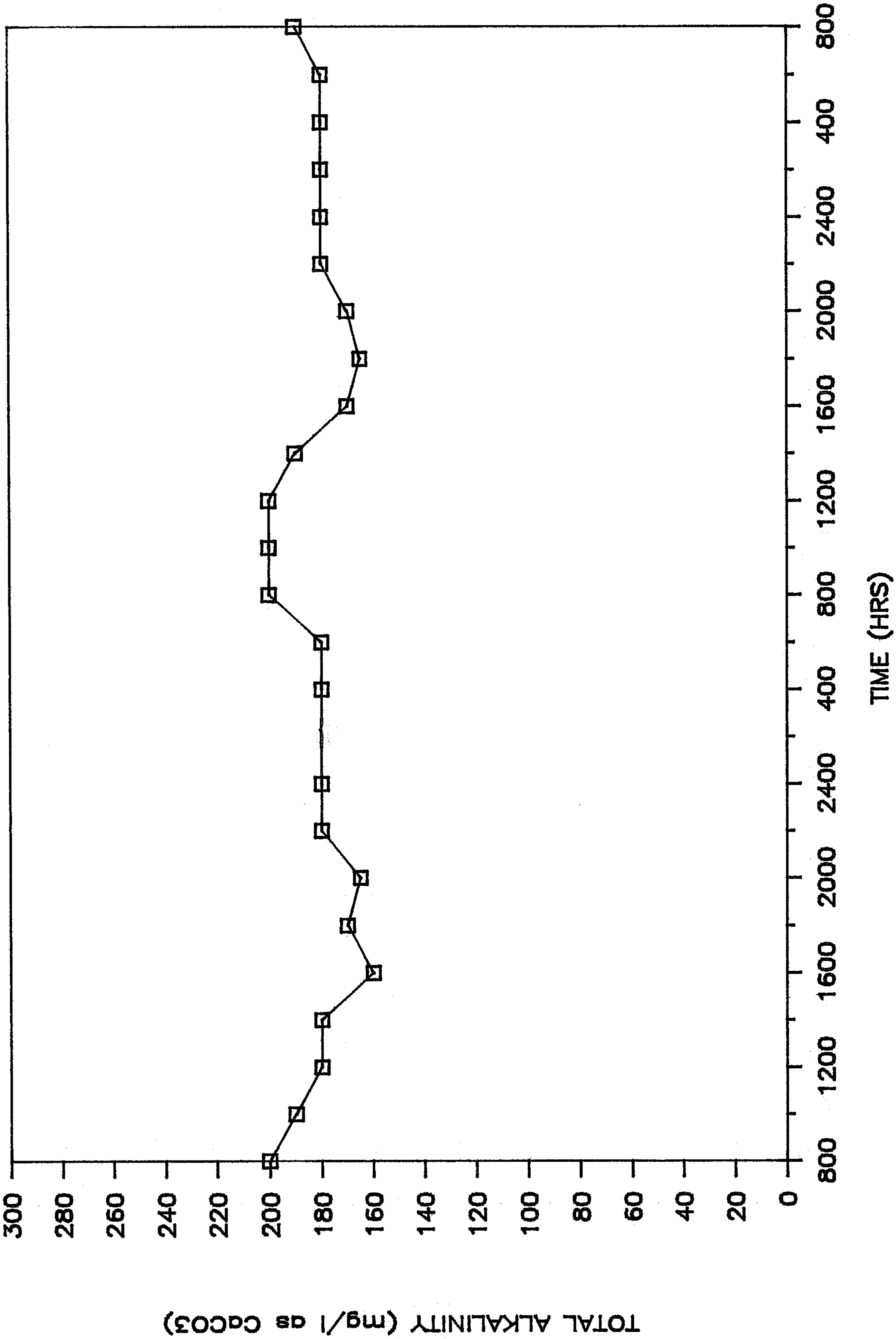


FIGURE IVC

TOTAL ALKALINITY AT PANOCHE



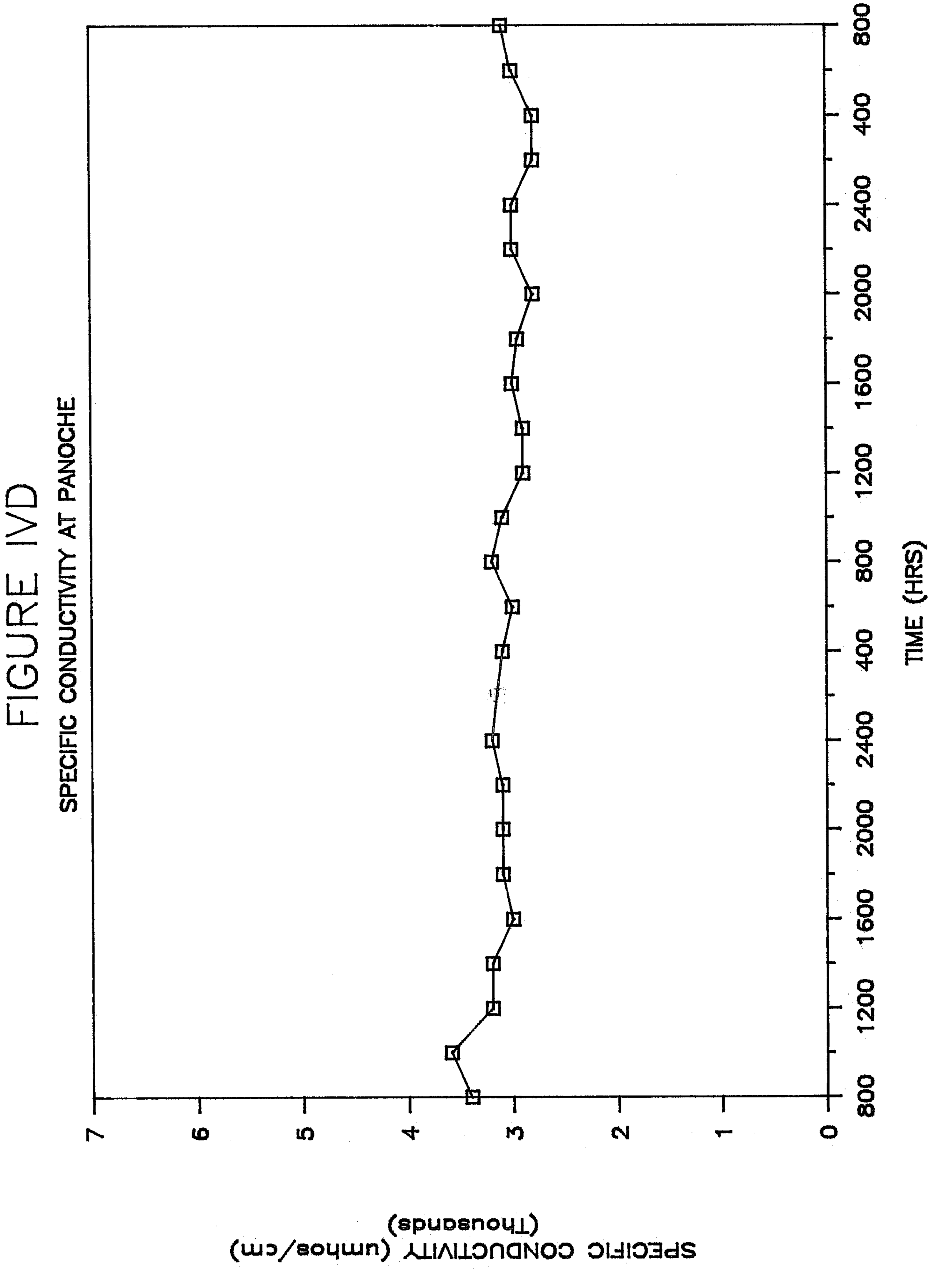


FIGURE IVD
SPECIFIC CONDUCTIVITY AT PANOCHE
SPECIFIC CONDUCTIVITY (umhos/cm)
(Thousands)
TIME (HRS)
0
1
2
3
4
5
6
7
800
1200
1600
2000
2400
400
800
1200
1600
2000
2400
400
800

FIGURE IVE

BORON CONCENTRATIONS AT PANOCHE

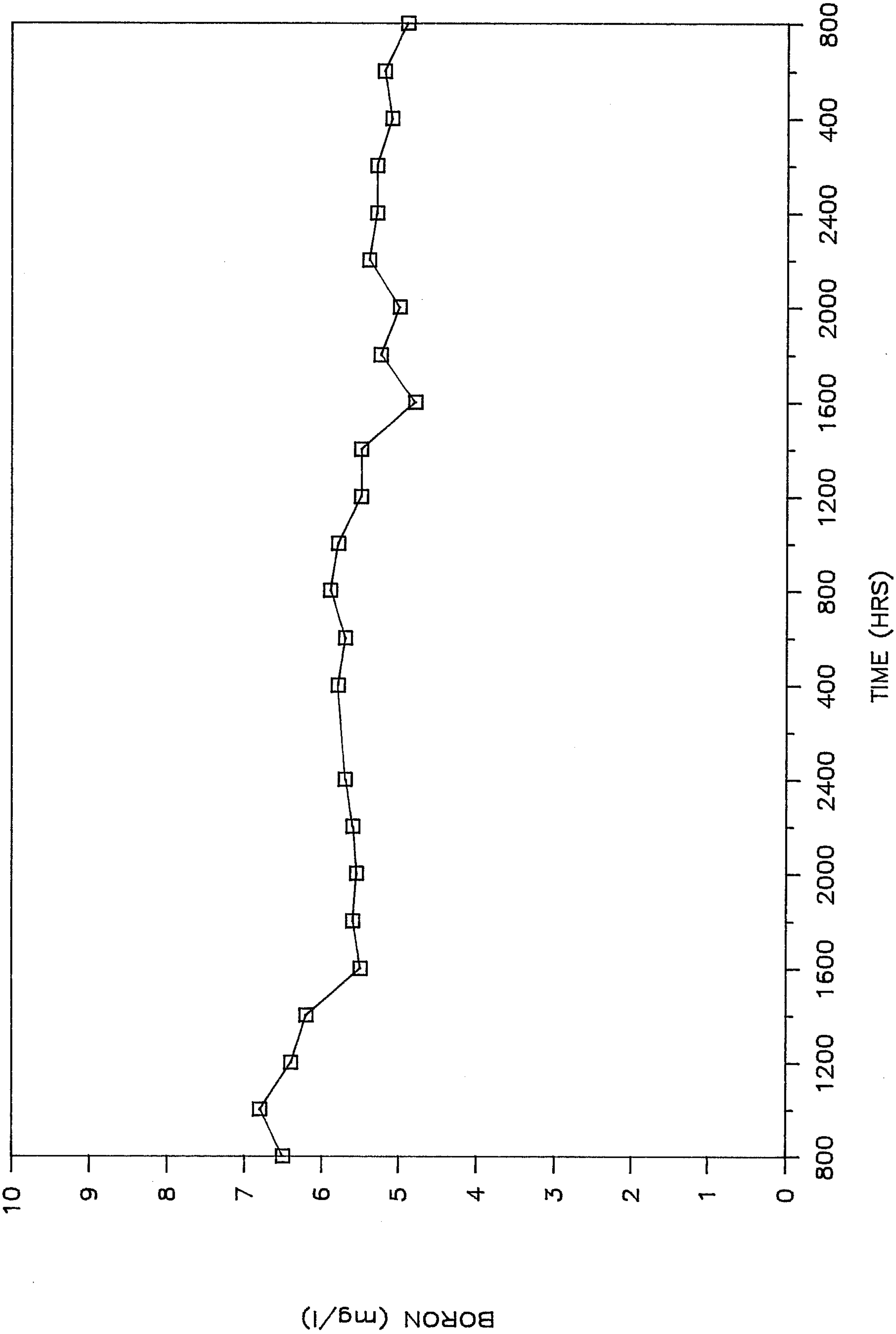


FIGURE IVF

SELENIUM CONCENTRATIONS AT PANOCHE

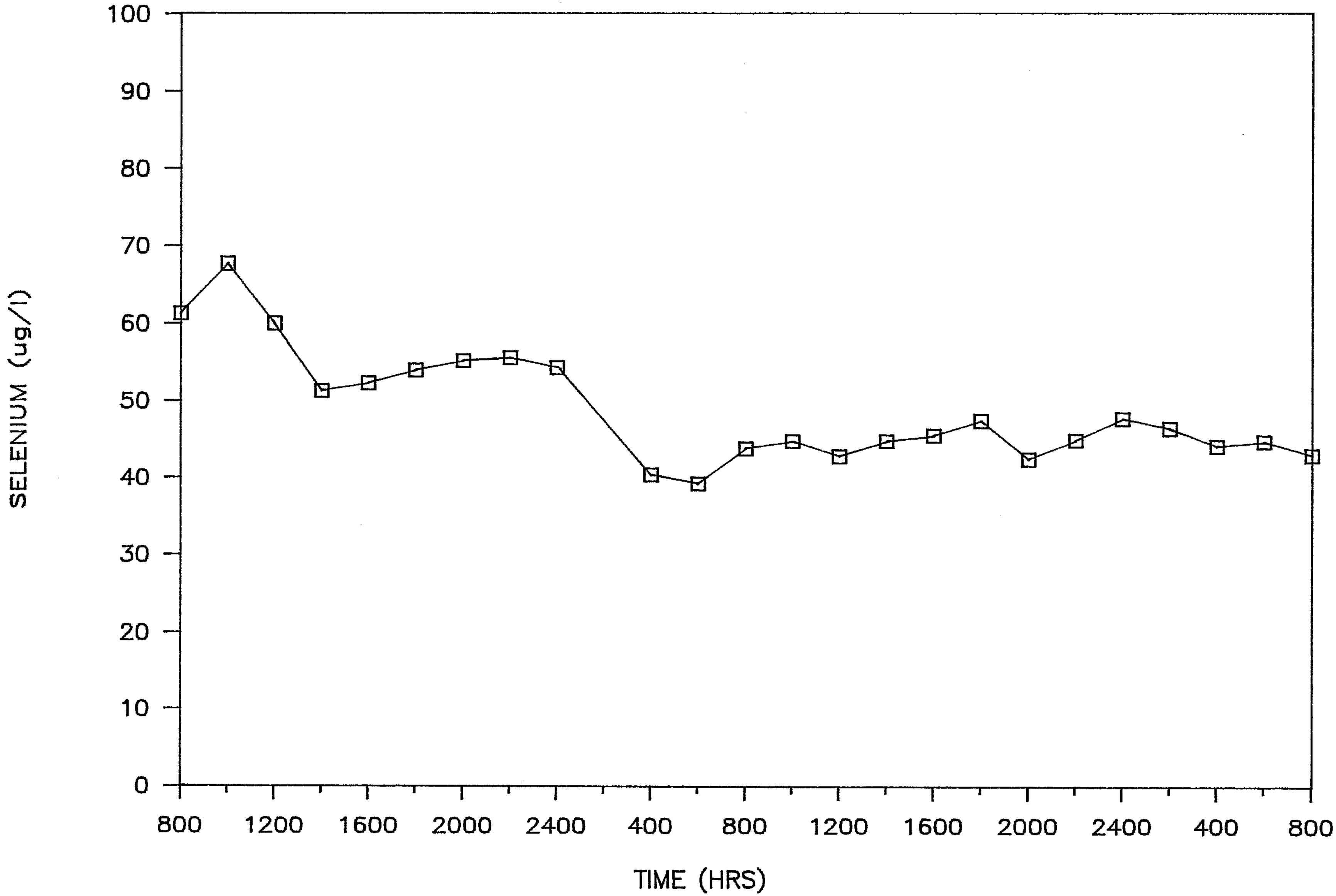


FIGURE 1G

CHARLESTON DRAIN SAMPLING ERROR

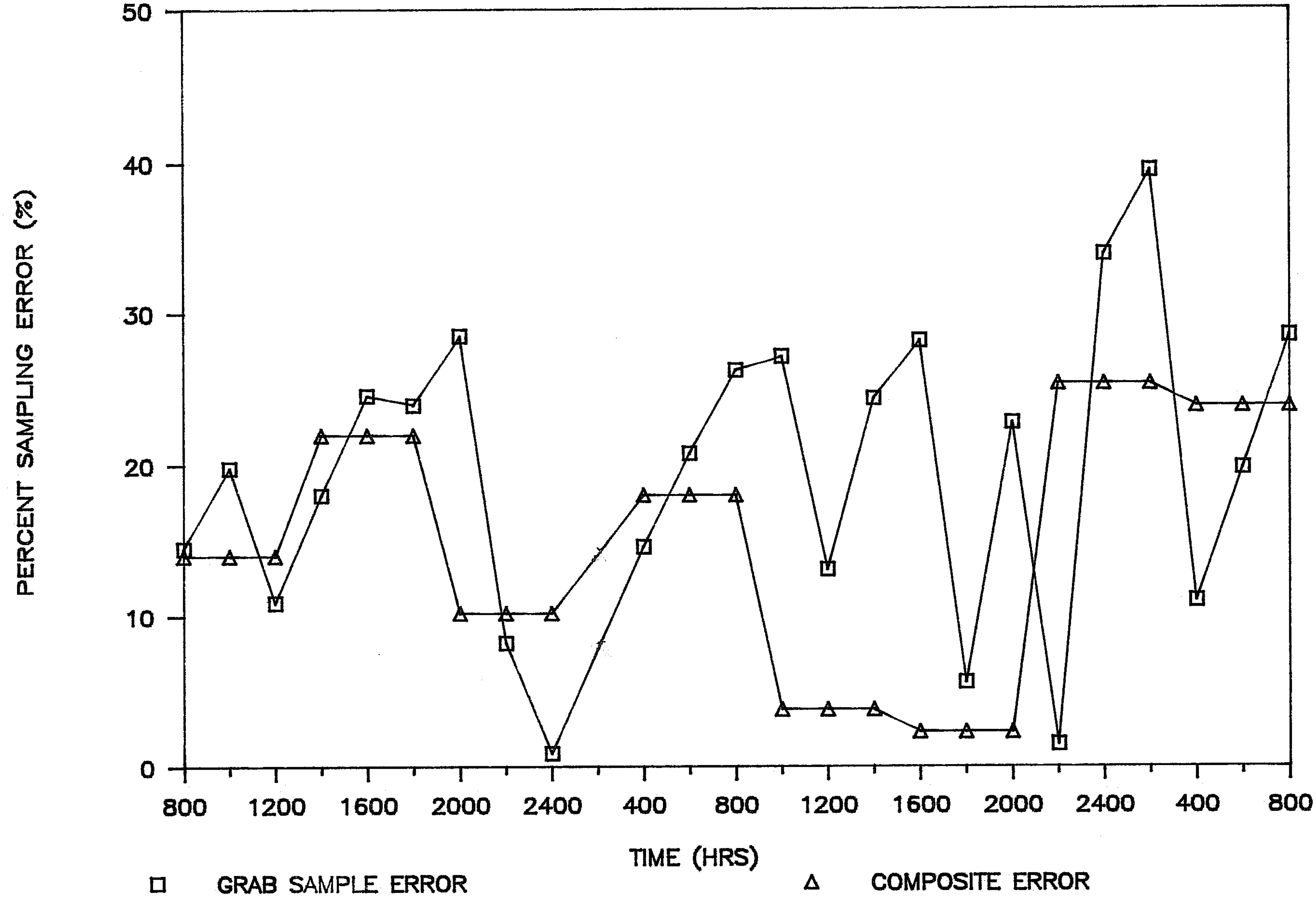


FIGURE IIG

HAMBURG DRAIN SAMPLING ERROR

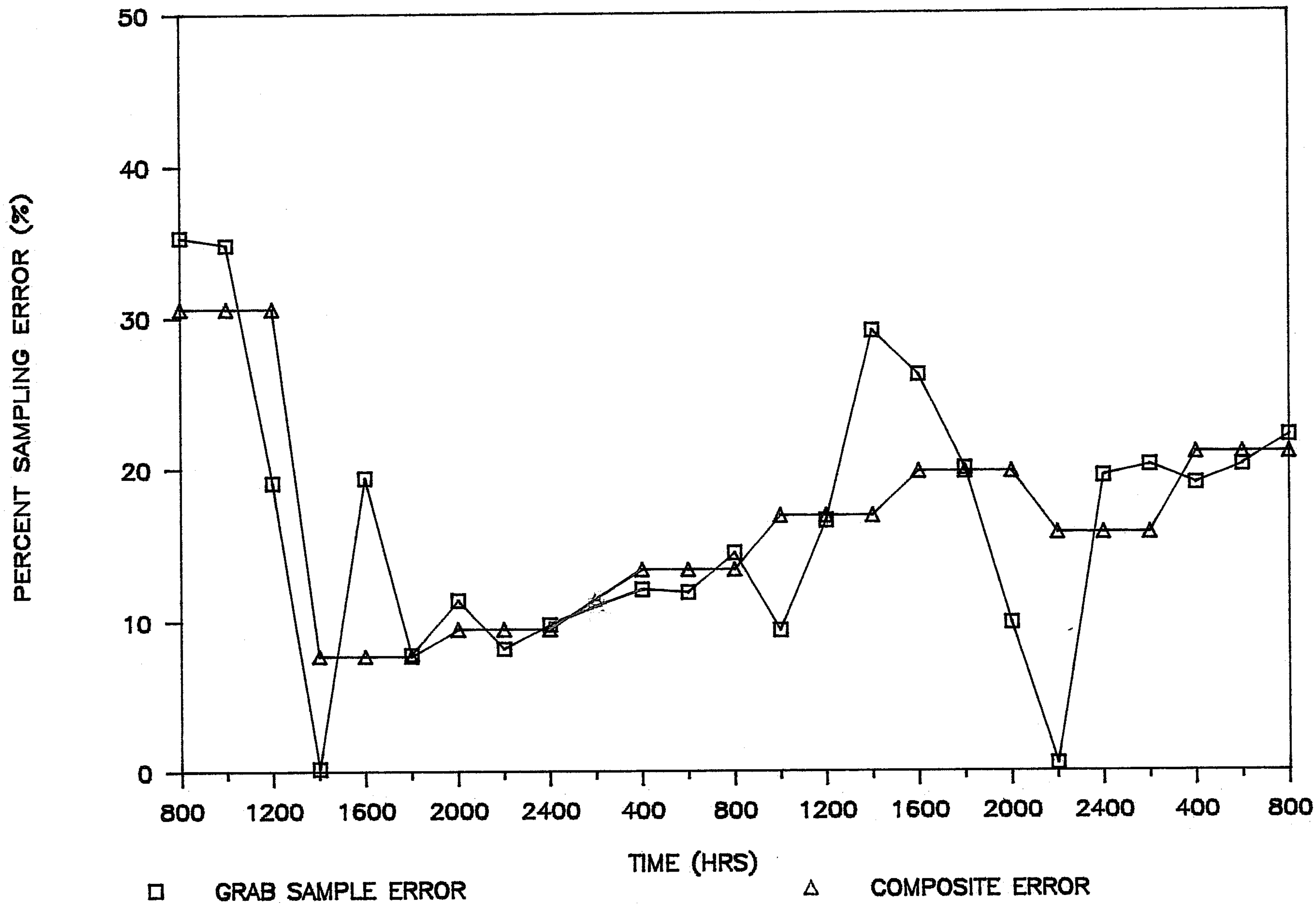


FIGURE IIIG

FIREBAUGH DRAIN SAMPLING ERROR

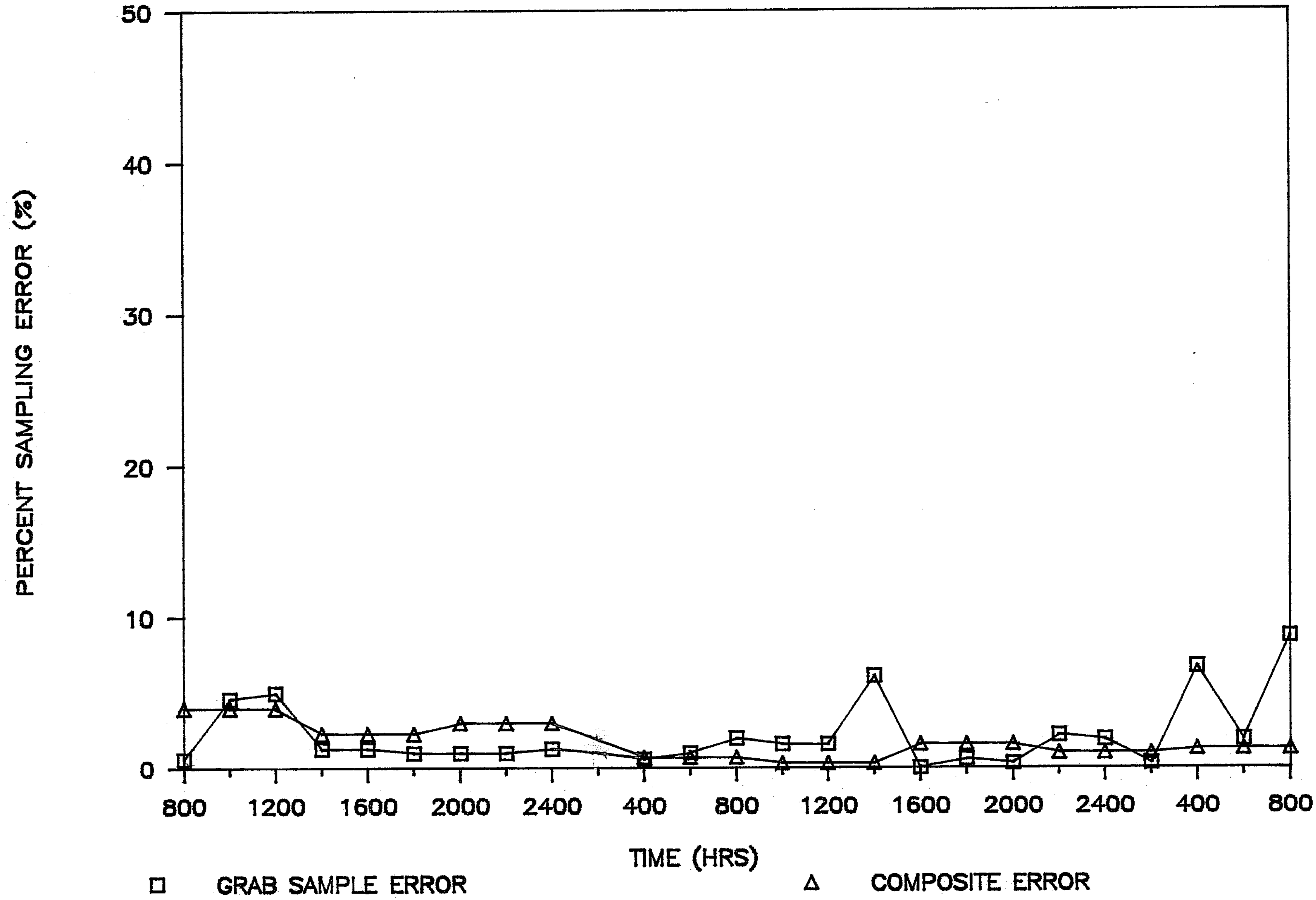


FIGURE IVG

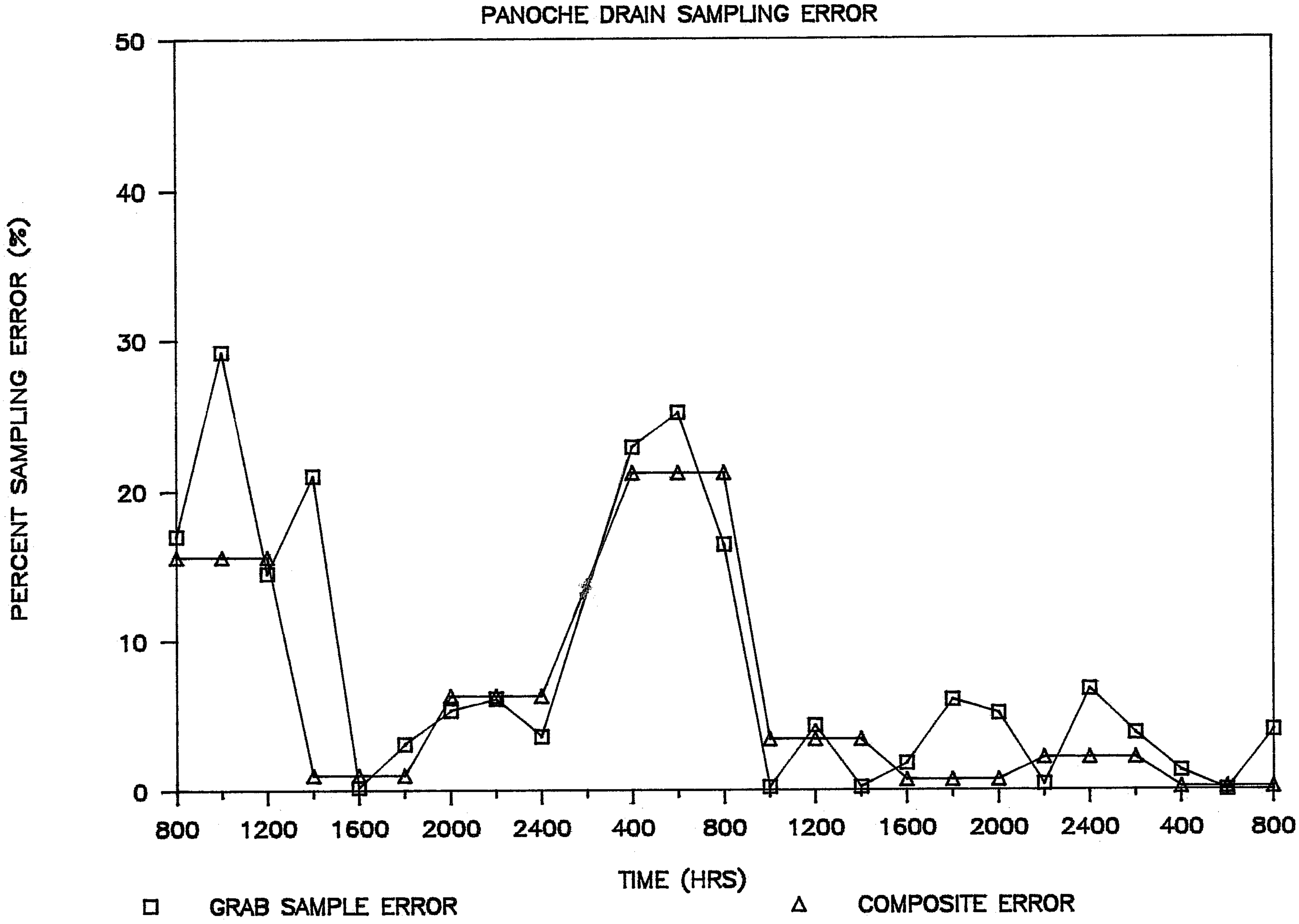

PANOCHE DRAIN SAMPLING ERROR
PERCENT SAMPLING ERROR (%)
50
40
30
20
10
0
800
1200
1600
2000
2400
400
800
1200
1600
2000
2400
400
800
TIME (HRS)
GRAB SAMPLE ERROR
COMPOSITE ERROR

FIGURE V

ANNUAL FLOW versus SAMPLING ERROR

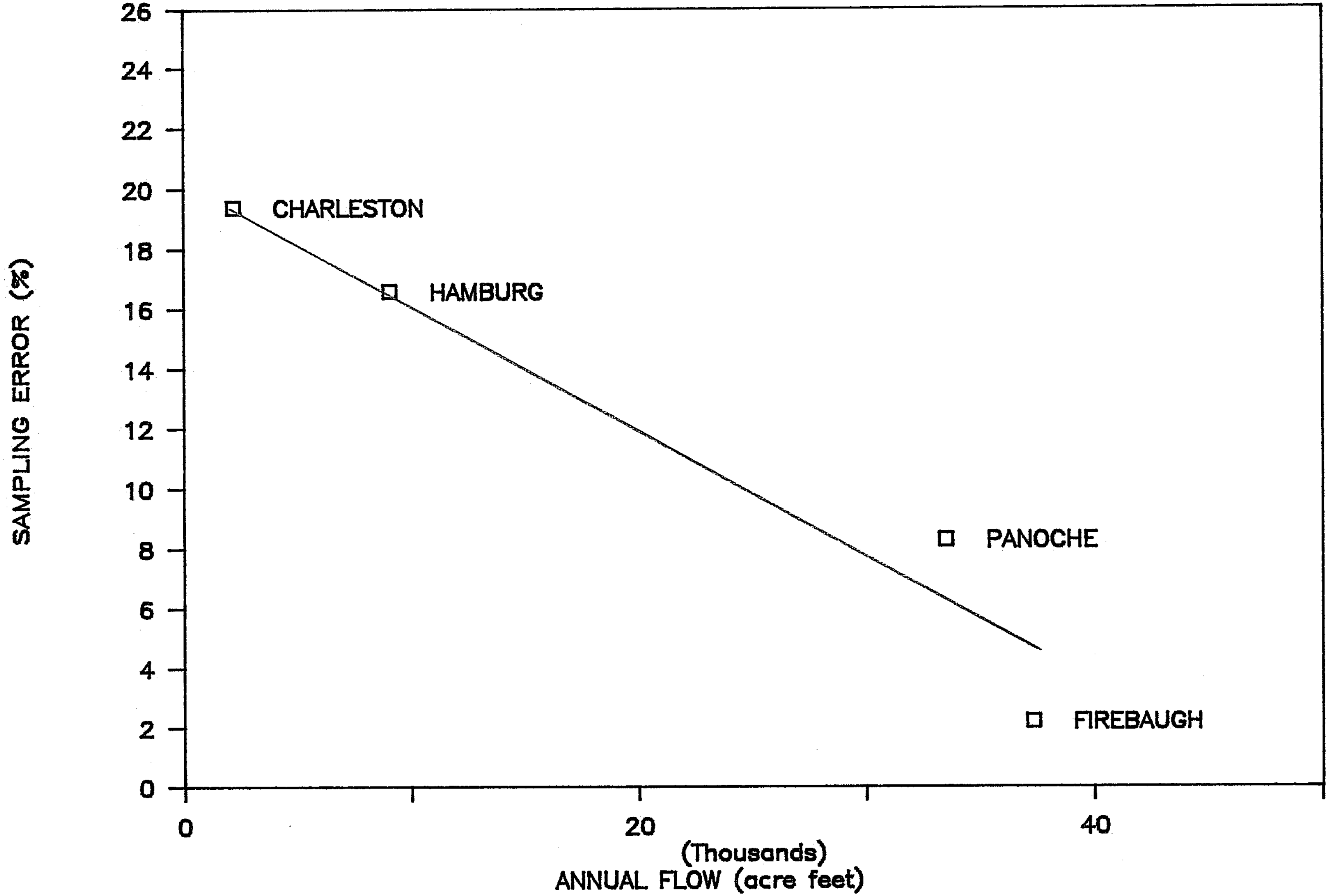


TABLE A1

RESULTS OF CHARLESTON DRAIN CONSTITUENTS

TIME	CHLORIDE (mg/l)	SULFATE (mg/l)	TOTAL ALK. (mg/l CaCO3)	EC (umhos)	BORON (mg/l)	SELENIUM (ug/l)
800	470	1100	150	3700	4.5	55
1000	180	1000	140	3400	3.6	52
1200	480	1100	130	3700	4.3	57
1400	630	1500	170	4900	5.6	76
1600	730	1650	165	5350	6.0	81
1800	700	1700	170	5100	5.7	80
2000	700	1600	160	5200	5.7	83
2200	590	1300	160	4700	5.1	70
2400	640	1600	160	4200	4.8	64
200	*	*	*	*	*	*
400	500	1300	150	3900	4.2	55
600	440	1200	140	3700	3.8	51
800	460	1100	140	3400	3.7	47
1000	450	1000	140	3100	3.5	44
1200	460	1100	150	3500	3.8	53
1400	700	1600	165	4700	5.3	75
1600	670	1800	160	5000	5.9	78
1800	560	1500	150	4300	4.8	64
2000	400	1100	140	3400	3.7	47
2200	480	1300	150	4100	4.5	60
2400	735	1700	160	5050	5.9	81
200	770	1900	170	5200	5.8	85
400	480	1100	120	3700	4.0	54
600	380	870	120	3200	3.6	42
800	370	870	44	3200	4.9	43
AVERAGE VALUE	540	1330	150	4150	4.7	62
MINIMUM VALUE	180	870	44	3100	4.5	42
MAXIMUM VALUE	770	1900	170	5350	6.0	85
STANDARD DEV.	140	300	25	740	0.9	14

* NO SAMPLE TAKEN

TABLE A2

RESULTS OF HAMBURG DRAIN CONSTITUENTS

TIME	CHLORIDE (mg/l)	SULFATE (mg/l)	TOTAL ALK. (mg/l CaCO3)	EC (umhos)	BORON (mg/l)	SELENIUM (ug/l)
800	330	735	100	2600	3.1	39
1000	350	860	110	3000	3.8	39
1200	410	950	110	3100	4.2	49
1400	510	1200	120	3800	6.3	61
1600	670	1600	150	5200	7.8	73
1800	600	1400	88	4400	6.2	66
2000	620	1400	88	4600	6.2	68
2200	610	1500	140	4400	6.4	66
2400	675	1550	125	4300	6.4	67
200	*	*	*	*	*	*
400	600	1600	120	4500	6.4	68
600	590	1600	130	5100	6.4	68
800	650	1600	130	4500	6.3	70
1000	680	1550	64	4400	6.4	67
1200	670	1500	64	4700	6.6	71
1400	740	1600	56	4800	6.1	79
1600	680	1800	60	5000	7.6	77
1800	690	1800	72	5000	7.6	73
2000	620	1700	100	4500	7.4	67
2200	640	1600	140	4800	7.3	61
2400	550	1400	140	4100	6.2	49
200	550	1500	140	3600	5.8	49
400	530	1400	140	3900	6.0	49
600	520	1400	150	4400	5.2	49
800	500	1400	130	4100	5.3	47
AVERAGE VALUE	580	1450	110	4300	6.1	61
MINIMUM VALUE	330	735	56	2600	3.1	39
MAXIMUM VALUE	740	1800	150	5200	7.8	79
STANDARD DEV.	110	270	30	700	1.2	11

* NO SAMPLE TAKEN

TABLE A3

RESULTS OF FIREBAUGH DRAIN CONSTITUENTS

TIME	CHLORIDE (mg/l)	SULFATE (mg/l)	TOTAL ALK. (mg/l CaCO3)	EC (umhos)	BORON (mg/l)	SELENIUM (ug/l)
800	180	600	150	2000	2.8	30
1000	180	550	150	1900	2.8	31
1200	180	570	160	2000	2.9	31
1400	155	475	135	1750	2.5	30
1600	190	570	140	2000	2.8	30
1800	180	540	150	2000	2.8	30
2000	170	520	160	2100	2.8	29
2200	170	520	200	2000	2.9	29
2400	190	570	150	2000	2.8	29
200	*	*	*	*	*	*
400	180	610	160	2000	2.8	30
600	170	605	155	1900	2.8	29
800	160	600	160	2000	2.8	30
1000	190	560	150	1900	2.9	30
1200	190	570	160	1900	2.7	30
1400	180	560	160	2000	2.7	33
1600	360	630	150	2000	2.9	31
1800	180	610	160	2000	2.9	31
2000	180	600	150	2000	2.9	31
2200	170	590	160	2000	3.0	30
2400	180	570	150	2000	2.9	31
200	190	610	240	2000	2.9	31
400	180	570	160	1900	2.8	33
600	185	580	160	2100	3.1	31
800	180	580	160	2100	2.8	33
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AVERAGE VALUE	190	570	160	1980	2.8	31
MINIMUM VALUE	155	475	135	1750	2.6	29
MAXIMUM VALUE	360	630	240	2100	3.1	33
STANDARD DEV.	40	35	20	75	0.1	1.1

* NO SAMPLE TAKEN

TABLE A4

RESULTS OF PANOCHE DRAIN CONSTITUENTS

TIME	CHLORIDE (mg/l)	SULFATE (mg/l)	TOTAL ALK. (mg/l as CaCO3	SPEC. CON (uhmos/cm	BORON (mg/l)	SELENIUM (ug/l)
800	470	920	200	3400	6.5	61
1000	450	920	190	3600	6.8	67
1200	430	860	180	3200	6.4	60
1400	380	860	180	3200	6.2	51
1600	470	910	160	3000	5.5	52
1800	370	790	170	3100	5.6	54
2000	360	760	165	3100	5.5	55
2200	400	850	180	3100	5.6	55
2400	400	860	180	3200	5.7	54
200	*	*	*	*	*	*
400	360	880	180	3100	5.8	40
600	350	850	180	3000	5.7	39
800	360	870	200	3200	5.9	43
1000	410	830	200	3100	5.8	44
1200	380	800	200	2900	5.5	42
1400	380	810	190	2900	5.5	44
1600	360	880	170	3000	4.8	45
1800	330	835	165	2950	5.2	47
2000	310	780	170	2800	5.0	42
2200	320	810	180	3000	5.4	44
2400	360	770	180	3000	5.3	47
200	360	750	180	2800	5.3	46
400	350	730	180	2800	5.1	44
600	340	710	180	3000	5.2	44
800	350	750	190	3100	4.9	42
AVERAGE VALUE	380	820	180	3100	5.6	48
MINIMUM VALUE	310	710	160	2800	4.8	39
MAXIMUM VALUE	470	920	200	3600	6.8	67
STANDARD DEV.	40	60	10	180	0.5	7.2

* NO SAMPLE TAKEN

TABLE B1

CHARLESTON DRAIN COMPOSITE SELENIUM DATA

TIME	GRAB SAMPLE SE DATA (ug/l)	6 HOUR COMPOSITE SE DATA (ug/l)	24 HOUR AVERAGE (ug/l)	GRAB vs. 6 HOUR (% DIFF)	GRAB vs. 24 HOUR (% DIFF)	6 HOUR vs. 24 HOUR (% DIFF)
800	55	55	65	0.5	14.5	14.0
1000	52	55	65	6.8	19.8	14.0
1200	57	55	65	3.6	10.9	14.0
1400	76	79	65	3.3	18.0	22.0
1600	81	79	65	2.1	24.6	22.0
1800	80	79	65	1.6	24.0	22.0
2000	83	71	65	16.6	28.5	10.2
2200	70	71	65	1.8	8.2	10.2
2400	64	71	65	10.1	0.9	10.2
200	*	*	*	*	*	*
400	55	53	65	4.1	14.6	18.0
600	51	53	65	3.4	20.8	18.0
800	47	53	65	10.1	26.3	18.0
1000	44	58	61	24.4	27.2	3.8
1200	53	58	61	9.7	13.1	3.8
1400	75	58	61	29.3	24.4	3.8
1600	78	62	61	25.3	28.2	2.3
1800	64	62	61	3.2	5.6	2.3
2000	47	62	61	24.5	22.8	2.3
2200	60	76	61	21.4	1.5	25.4
2400	81	76	61	6.8	33.9	25.4
200	85	76	61	11.2	39.5	25.4
400	54	46	61	17.0	11.0	23.9
600	48	46	61	5.3	19.8	23.9
800	43	46	61	6.0	28.5	23.9
			AVERAGE	10.3	19.4	15.0
			MAXIMUM	29.3	39.5	25.4

* NO SAMPLE TAKEN

TABLE B2

HAMBURG DRAIN COMPOSITE SELENIUM DATA

TIME	GRAB SAMPLE (ug/l)	6 HOUR COMPOSITE (ug/l)	24 HOUR AVERAGE (ug/l)	GRAB vs. 6 HOUR (% DIFF)	GRAB vs. 24 HOUR (% DIFF)	6 HOUR vs. 24 HOUR (% DIFF)
800	39	42	61	6.8	35.3	30.6
1000	39	42	61	6.1	34.8	30.6
1200	49	42	61	16.5	19.1	30.6
1400	61	65	61	7.0	0.2	7.7
1600	73	65	61	10.9	19.4	7.7
1800	66	65	61	0.2	7.8	7.7
2000	68	67	61	1.8	11.4	9.5
2200	66	67	61	1.2	8.2	9.5
2400	67	67	61	0.3	9.8	9.5
200	*	*	*	*	*	*
400	68	69	61	1.2	12.1	13.4
600	68	69	61	1.3	11.9	13.4
800	70	69	61	1.0	14.5	13.4
1000	67	71	61	6.4	9.4	16.9
1200	71	71	61	0.3	16.6	16.9
1400	79	71	61	10.4	29.1	16.9
1600	77	73	61	5.3	26.2	19.8
1800	73	73	61	0.1	20.0	19.8
2000	67	73	61	8.2	9.9	19.8
2200	61	51	61	18.1	0.5	15.8
2400	49	51	61	4.4	19.5	15.8
200	49	51	61	5.2	20.2	15.8
400	49	48	61	2.5	19.0	21.0
600	49	48	61	1.0	20.2	21.0
800	47	48	61	1.4	22.1	21.0
			AVERAGE	4.9	16.6	16.8
			MAXIMUM	18.1	35.3	30.6

* NO SAMPLE TAKEN

TABLE B3

FIREBAUGH DRAIN COMPOSITE SELENIUM DATA

TIME	GRAB SAMPLE (ug/l)	6 HOUR COMPOSITE (ug/l)	24 HOUR AVERAGE (ug/L)	GRAB vs. 6 HOUR (% DIFF)	GRAB vs. 24 HOUR (% DIFF)	6 HOUR vs. 24 HOUR (% DIFF)
800	30	31	30	3.2	0.6	4.0
1000	31	31	30	0.6	4.6	4.0
1200	31	31	30	1.0	5.0	4.0
1400	30	29	30	3.7	1.3	2.3
1600	30	29	30	3.7	1.3	2.3
1800	30	29	30	3.4	1.0	2.3
2000	29	29	30	2.0	1.0	3.0
2200	29	29	30	2.0	1.0	3.0
2400	29	29	30	1.7	1.3	3.0
200	*	*	*	*	*	*
400	30	30	30	1.3	0.6	0.7
600	29	30	30	1.6	1.0	0.7
800	30	30	30	1.3	2.0	0.7
1000	30	31	31	1.3	1.6	0.3
1200	30	31	31	1.9	1.6	0.3
1400	33	31	31	6.4	6.1	0.3
1600	31	30	31	1.6	0.0	1.6
1800	31	30	31	2.3	0.6	1.6
2000	31	30	31	2.0	0.3	1.6
2200	30	31	31	3.2	2.2	1.0
2400	31	31	31	1.0	1.9	1.0
200	31	31	31	1.3	0.3	1.0
400	33	31	31	5.1	6.7	1.3
600	31	31	31	2.5	1.9	1.3
800	33	31	31	7.3	8.7	1.3
			AVERAGE	2.6	2.2	1.8
			MAXIMUM	7.3	8.7	4.0

* NO SAMPLE TAKEN

TABLE B4

PANOCHE DRAIN COMPOSITE SELENIUM DATA

TIME	GRAB SAMPLE (ug/l)	6 HOUR COMPOSITE (ug/l)	24 HOUR AVERAGE (ug/L)	GRAB vs. 6 HOUR (% DIFF)	GRAB vs. 24 HOUR (% DIFF)	6 HOUR vs. 24 HOUR (% DIFF)
800	61	60	52	1.2	17.0	15.6
1000	67	60	52	11.7	29.2	15.6
1200	60	60	52	1.0	14.5	15.6
1400	51	51	52	1.2	21.0	1.0
1600	52	51	52	0.8	0.2	1.0
1800	54	51	52	4.0	3.1	1.0
2000	55	55	52	0.9	5.3	6.3
2200	55	55	52	0.2	6.1	6.3
2400	54	55	52	2.5	3.6	6.3
200	*	*	*	*	*	*
400	40	41	52	2.2	22.9	21.2
600	39	41	52	5.1	25.2	21.2
800	43	41	52	6.1	16.4	21.2
1000	44	43	44	3.7	0.2	3.4
1200	42	43	44	0.9	4.3	3.4
1400	44	43	44	3.7	0.2	3.4
1600	45	45	44	1.1	1.8	0.7
1800	47	45	44	5.3	6.0	0.7
2000	42	45	44	5.8	5.1	0.7
2200	44	45	44	1.8	0.4	2.2
2400	47	45	44	4.4	6.7	2.2
200	46	45	44	1.5	3.8	2.2
400	44	44	44	1.6	1.3	0.2
600	44	44	44	0.2	0.0	0.2
800	42	44	44	4.2	4.0	0.2
			AVERAGE	3.0	8.3	6.4
			MAXIMUM	11.7	29.2	21.2

* NO SAMPLE TAKEN